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McGraw-Hill Consolidation

LAST week we commented briefly on the coming consolidation of Engineering Record and Engineering News, but recorded in a news note only the larger merger—that of the McGraw Publishing Company, Inc., with the Hill Publishing Company. To the readers of the Engineering Record the News-Record consolidation is of the greater direct interest, yet the influence of the union of the two big publishing properties will have a great and beneficial influence, not only on the Engineering News-Record, but on the whole field of engineering. For the first time there is represented in one great publishing house strong magazines in each of the five major fields of engineering. The McGraw company had papers in the civil, electrical and chemical engineering fields; the Hill company in the civil, mechanical and mining fields. Now all the journals are in the McGraw-Hill Publishing Company, Inc. What this means to the entire profession is obvious. The editors will be brought close together and will bring to the common council the views of each branch of the profession. The readers of each journal are, therefore, assured of the most comprehensive views of big issues. There are other and not a whit less important benefits. The large number of papers to be served will make it possible to organize the country editorially in a very efficient way, insuring a service to readers that even the constituent companies, strong as they were, found it impossible to render. Then the number of fields represented introduces a stabilizing diversity factor that will insure the maintenance of an unparalleled service in all the journals, despite adverse financial conditions in one or two fields. And even as the editors of the Engineering News-Record recognize their responsibility in speaking each week to 75,000 or 100,000 engineers and contractors, so do the publishers recognize their larger responsibility to the entire engineering field. They have confidence that their ideals are understood by the engineering world. Papers like Power, Engineering and Mining Journal, Electrical World, Engineering News and Engineering Record have written themselves into the histories of their respective fields. The old ideals of these journals—so religiously adhered to through a generation—will be upheld.

Canadian Engineer-Soldiers

FOREIGN PAPERS bring the news of the human toll that the war is taking from the engineering profession. The English papers tell the story in almost each issue, as did the German technical periodicals during the time when they were still coming. In Canada, likewise, the war is exacting its price. Twenty-four per cent of the membership of the Canadian Society of Civil Engineers (which has 3200 members) has enlisted and 34 of them have been killed. Surprisingly, too, the majority of those who have enlisted are not juniors. The associate members in khaki outnumber the junior enlistment 2 to 1. In a word, the engineers of Canada are true patriots. In the great trial to which the Empire is being subjected, they are willingly bearing their part.

Frozen Concrete Failure

THE FAILURE of the roof of a reinforced-concrete building at Omaha, Neb., reported in the news section this week, again calls attention to the dangers of winter concreting and the results of inadequate protection of materials and finished structures from freezing temperatures. Possibly due to a wider knowledge of the precautions necessary to prevent such failures (see the Engineering Record of Sept. 9, 1916, page 319), there have been relatively few such failures reported during the past winter. The present instance, while not perfectly definite as to the exact details of the causes of failure, gives every evidence that freezing temperature at the time of placing, followed by failure to protect the top surface of the concrete roof, combined with the drying-out effect of the heat from salamanders below the roof, sufficed to prevent setting of the concrete and the development of bond between concrete and steel. The fact that concrete over two and a half months old, if subjected to freezing and thawing during that time and then suddenly thawed out completely, will immediately fall of its own weight is an impressive lesson. The necessity for heat and moisture at least sufficient to allow complete setting of the cement is thus again driven home by the loss of part of a completed structure.

Another Test Discredited

SCIENTISTS are too ready to propose and engineers too eager to accept a new technical definition or specification, especially in these days of the rapid development of the research and control laboratory. Too many half-considered and only partially demonstrated tests are adopted—frequently to find an honored and unquestioned place in "standard" specifications. We have witnessed the advent, the accompanying disturbance and the final disappearance of the autoclave tests, and wonder, occasionally, how many other technical tests are doomed to a similarly unmarked grave. The latest to receive its *coup de grâce* is the laboratory distillation of tar products, made to estimate the amount of change occurring in these materials on exposure to the action of air and sun. It would be impossible to estimate the amount of excellent material which has been condemned, nor the undoubtedly greater quantity of available tars which have been held as unfit because, forsooth, they have failed to meet the requirements of a test whose artificial nature should have brought it under suspicion from the moment of its proposal. It is unfortunate that, pressed by necessity, we must even tentatively adopt measures of quality before vigorous research has had its opportunity. It is fortunate, however, that we have such organizations as the laboratory of the U. S. Office of Public Roads, which can concern itself with these questions and ultimately render an unassailable decision. The work of C. S. Reeves and B. A. Anderton of the laboratory staff on "The Effect of Exposure on Tar Products," presented before the Franklin Institute, is based on sound experimentation, and its value is hardly to be overestimated. Some day in the not too distant future we may, perhaps, refer such questions in the first instance to adequate investigation.

Where Original Cost Was Found

COMMENT was made by this journal, in its issue of Jan. 27, page 128, on the tentative valuation of the Winston-Salem Southbound Railway, reported by the Interstate Commerce Commission. Attention was drawn to what seemed rather surprising, that, exclusive of land, reproduction cost totaled slightly less than original cost, and that for some items the reproduction figure was barely half that for original cost. There are, however, this journal has since learned, two circumstances which tend to explain the matter.

One is that the reproduction cost estimate does not include every item of original cost. It happens that on this short railroad there are four railroad crossings—some grade, some under. The Winston-Salem Southbound, being the junior road, had to pay the entire cost of all of these crossings. On the basis of use, however, which the Division of Valuation, in estimating reproduction cost, is using for allocating crossings to the railroads involved (where there is a dispute as to ownership) the newer road is allowed only half the cost of grade crossings and none of that of the bridges that carry the older road over the newer. Whether or not this basis of allocation will ultimately prevail—and the carriers opposed it vigorously at the recent hearing in Washington—it was applied to the valuation under discussion, and the four crossings mentioned absorbed no inconsiderable part of the original cost.

The other circumstance is that the Division of Valuation found it impossible to analyze all of the itemized original accounts of the railroad and in some cases found it undesirable as well, in reproduction, to follow the construction methods originally used. For example, expensive rock-crushing machinery at a quarry was charged against ballast in original cost, but against non-carrier lands and improvements in reproduction cost. The Division of Valuation found it quite impossible to analyze accurately such accounts as ballast and tracklaying to determine just what they did cover, but found that the sum of the ballasting and tracklaying accounts checked the sum of the same accounts in reproduction. Thus considering groups of related items, covering the same elements of physical plant, the Engineering Record is informed that reproduction cost and original cost compare very rationally, the former reflecting the normal trend of prices, but not the abnormal war-time figures.

Filtration, the First Line of Defense

AGAIN the city of Milwaukee has been told that its first line of sanitary defense is a filtration plant. This time it comes with the emphasis of a federal bureau, the U. S. Public Health Service. The facts, stated bluntly, are that the water is continuously polluted and that chlorine, in quantities below the complaint point, cannot kill enough of the germs to make the water safe. A typhoid-fever outbreak is feared this spring. Probably this is the most conspicuous example of a city which cannot make an emergency or factor-of-safety measure fill the place of permanent construction.

In January Dr. A. H. Glennan, acting surgeon-general of the Public Health Service, issued orders to common carriers by lake or rail to discontinue the use of the Milwaukee supply for drinking water for passengers in interstate traffic. This a severe indictment. If the water is not good enough for travelers, is it safe for local consumers? The officials should lose no time in accepting the advice in H. P. Letton's recent report to Mayor D. W. Hoan to hire experts at once to investigate, recommend and put into operation measures so recommended. Mr. Letton, who made the report on conditions for the Public Health Service, recommends that a study and experiments be made to ascertain whether rapid filters can be operated satisfactorily, some question having arisen as to the floc-producing properties of the lake water. In this connection the use of home-made alum, with all the impurities of the bauxite left in, would probably be considered.

With these views on the desirability of filtration John W. Alvord and Allen Hazen both concur in letters to George C. Ruhland, health commissioner. The former reiterates views expressed in the 1911 report of the Alvord-Eddy-Whipple sewerage commission to the effect that the filtration of the water supply ranks first in importance as the cheapest and most efficient health defense work that can be introduced in Milwaukee either now or in the future. Mr. Alvord also makes it plain that filtration of the water supply should be introduced at the earliest possible moment, in addition to the new intake and the proposed sewage treatment works.

The second line of defense is sewage treatment, but filtration is the first, because it deals directly with the water used by the people for domestic purposes; it is the more delicate and sensitive mechanism for the removal of slight pollution and it is standardized and reliable, 480 plants now serving successfully 40.6 per cent of the urban population of this country. It is apparent that Milwaukee needs both water filtration and sewage plants, and nothing said here is intended to minimize the sewage problem. Both are essential. Both should have been considered simultaneously.

The filter plant for 60,000,000 gal., estimated roughly by Mr. Alvord to cost from $1,300,000 to $1,600,000, could be in operation within two years. Will it take a serious typhoid epidemic to bring definite action? The Engineering Record thinks not, for on the committee recommended to the city council by the Mayor to investigate the Public Health Service report are several engineers, including George H. Benzenberg and T. Chalkley Hatton, who know the local situation thoroughly. Dirt should fly by fall.

Caisson Disease and Legislation

WHILE it is undoubtedly to the pecuniary advantage of the "sandhog" to implant in the mind of the general public the idea that the personal risk involved in his calling greatly increases, and that hours of work should be shortened and pay increased for every five or six pounds increase in pressure above 22 lb. to the square inch, it is nevertheless a demonstrated fact that such is not the case. Notwithstanding that the best engineering authorities were aware of the real nature of the risks to men working in compressed air work prior to 1909, the New York State legislature in that year enacted a law embodying provisions for decreasing the working time until a point was reached at 50 lb., where the men spent as much or more time getting into and out of the air chamber as they spent at work. And now Pennsylvania is reported to be considering a similar law.

Contractors in New York State have not seriously protested against this law, because it places all of them on the same footing. Nevertheless the law, which contains several inconsistencies, has increased the cost of compressed-air work in that state, and is now in a fair way to be copied by another important state.

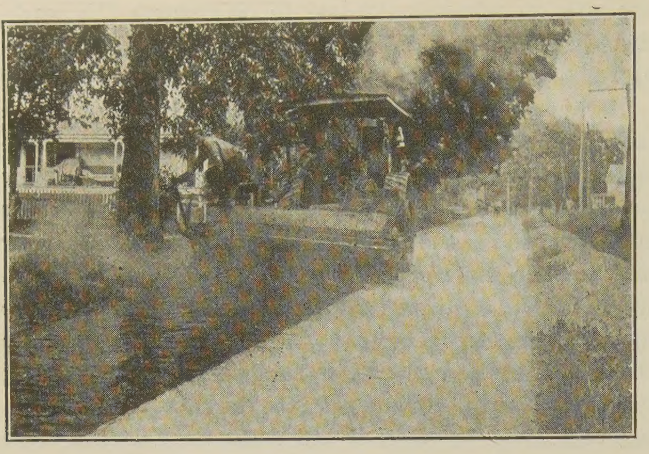
The best authorities on the subject of caisson disease assign as the cause of the disease the liberation of bubbles of nitrogen in the blood and tissues of the body during and after decompression. Since it has been demonstrated that the blood and tissues will dissolve nitrogen at the pressures encountered in compressed air work to 75 or 80 per cent of complete saturation within a short period after entering the working chamber, it is evident that the argument in favor of short working periods, unless these periods could be made actually shorter than 45 minutes, is groundless. It is well understood that, unless poisonous gases are encountered, the chief danger of attack from caisson disease lies in decompression. Therefore it is doubtful whether, except for very high pressures, it does not actually increase the risk of inducing sickness to decompress the workmen from working to normal pressure twice daily instead of once daily.

Perhaps because the matter is much easier to arrange in tunnel work by reason of the space available in large tunnel bulkheads for additional locks, the New York law prescribes a much slower rate of decompression for tunnel workers than for caisson workers. The only argument in favor of this discrimination against tunnel work is that a caisson starts off at low pressure, the men working in it becoming gradually accustomed to the higher pressures and working under them in any one caisson only a few days. On the other hand, working conditions in caissons are usually considered more severe than in tunnels. It would, therefore, seem that a law which prescribed decompression for tunnel workers at the rate of 1 lb. per minute, while providing for decompression of caisson workers from given working pressures in definite intervals of so many minutes at much more rapid rates, is at least not based on scientific knowledge.

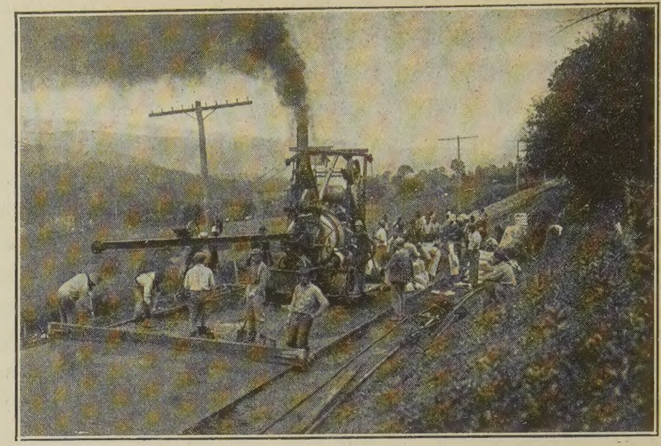
Another feature of this law that is detrimental to the safety of the workmen is that its wording definitely forbids stage decompression. In coming out of compressed air, it has been proved that the practice of reducing the air pressure rapidly to a point 20 lb. or more below the blood pressure will not give rise to the liberation of bubbles in the blood and tissues or to the symptoms of caisson disease. The law should permit stage decompression, known to be the safest method of bringing men out of compressed air, by stating that decompression should take a total time equivalent to a uniform reduction of 1 lb. per minute.

Before the New York law was enacted it was proved on the Pennsylvania tunnels under the East River that no valid argument based on additional safety to workmen can be made for decreasing the daily working period below 8 hours until a pressure of 32 lb. has been reached. Above this pressure, but below 42 lb. per square inch, the "sandhogs" on this contract worked 6 hours out of every 24, while above 42 lb. they worked 4 hours out of every 24. These working periods are much longer than those prescribed in the New York law, but it is a well-known fact that the work was carried out with a rate of sickness and death which is unusually low for such construction in New York City.

While these things are known to engineers familiar with work in compressed air, they are not known to legislators. The Pennsylvania legislature, which, it is understood, has in committee a bill similar to the New York law, should be informed on this subject by engineers before this bill can be enacted into a harmful statute. At least, those engaged in construction requiring the use of compressed air in caissons and tunnels should not sit by and allow the general public to gain the impression that the New York law and the law proposed in Pennsylvania represent the last word in safety practice for compressed-air workers when some of the provisions of these laws are actually more dangerous to workers than accepted engineering practice.



TAR-MACADAM WEARING SURFACE, 1 INCH THICK, WAS PUT DOWN IN TWO APPLICATIONS



CONCRETE PLANT, SHOWING DISTRIBUTION OF MATERIALS AND MEN IN LAYING PAVEMENT BASE

Tar Macadam on Concrete Base Serves Both Motor and Horse Traffic

In Early Work Top Course, ¼ Inch Thick, Peeled Off, But 1-Inch Surfacing Later Proved Satisfactory on New York State Highway

By P. H. BRIGHAM
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TO FULFILL the dual objects of carrying a heavy seasonal automobile traffic and of providing a roadbed which would be easy on the hoofs of cattle and horses a tar macadam carpet 1 in. thick on a 5 in. concrete base, 1:2½:5 mix, was the type of pavement selected for 7¾ miles of New York State highway traversing the prosperous farming and summer-resort district in the Susquehanna Valley between Cooperstown and Milford. Roads of the same general type, but with a top course only ¼ in. thick, were built a few years ago. They proved failures, however, because the wearing surface was so thin that the calks on horses' shoes pierced it, allowing moisture to penetrate between the base and the top course. The result was that the surfacing either peeled off in large patches or slid, leaving alternate bare spots and bumps. This fault was remedied in the present design by allowing a finished thickness of top course of at least 1 in.

VOLUME OF TRAFFIC

The territory which this road serves contains a large number of dairy farms specializing in pure-bred Holstein-Friesian cattle. Cooperstown itself is a well known summer resort and attracts many automobiles during the summer months. The traffic on holidays and week days throughout the valley amounts to about 1000 automobiles a day, a fair average for the entire season being 500 cars. Horse-drawn vehicles average about 100 a day, carrying milk, hops and other farm produce.

Several of the tar-macadam roads with the ¼-in. wearing course were built in 1912 and 1913.

A similar pavement 14 ft. wide, with a ¾-in. top course and 28 ft. roadway, was built in 1912 between Rockdale and Mount Upton, N. Y., a distance of 2.33 miles. The total construction cost of this highway was $13,360 per mile; the cost per square yard of pavement was $0.942. The subsequent maintenance cost is given in the table.

The maintenance charges on the Rockdale-Mount Upton road for 1916 are not yet available. Although the traffic on this road is not quite as heavy as through the upper Susquehanna Valley, yet the figures probably give a reasonably accurate forecast of the maintenance costs of the Cooperstown highway.

CONSTRUCTION METHODS FOR CONCRETE BASE

Work on the Milford-Cooperstown state highway commenced in April, 1915. Due to the scarcity of commercial crushed stone in the fall of 1915, most of the top course was placed during the early summer of 1916. The road was 7.75 miles long and the pavement width 14 ft., except about ½ mile in the village of Milford, which was 16 ft. wide. The roadway width between ditches was 24 ft. and 26 ft. respectively. Wherever quicksand or springs were encountered, an extra foundation of stone or coarse gravel was used under the pavement, together with 6-in. vitrified tile drains. The tile was placed about 3 ft. below the ditch line and

MAINTENANCE COST, ¾-INCH TAR MACADAM TOP ON CONCRETE BASE, ROCKDALE-MOUNT UPTON ROAD

Year	Item	Total Cost	Cost per Mile
1913	None	......	
1914	Repairs to surface	$37.66	
	Patrol	156.00	
	Total, 1914	$193.66	$83
1915	Repairs to surface	33.49	
	Patrol	228.00	
		$261.49	$112
	Painting guard railing	63.10	
	Cleaning shoulders and ditches	227.56	
	Total, 1915	$552.15	

covered to within 6 in. of the ditch grade with crushed stone, the remainder of the backfill being the most impervious material at hand. After the subgrade was shaped and thoroughly rolled, the sand and stone were distributed in winrows inside the form line and at least ½ mile ahead of the mixing.

Two mixers with boom and bucket attachment were employed, the mixture staying in the drum at least 1 min., with an average of 18 r.p.m. One of the mixers, requiring a fireman and two operators, mixing one-bag batches, began work on June 22, 1915, and in 43 working days laid 20,713 lin. ft. of foundation. The other, needing but one operator, mixing two-bag batches, began work on July 30, 1915, and in 37 working days laid 20,250 lin. ft. of concrete base. The maximum daily output was made by the latter, being 797 lin. ft. of 14-ft. foundation. The total elapsed time for placing the concrete on the entire road was June 22, 1915, to Sept. 20, 1915, inclusive.

FREQUENT CEMENT STORAGE PILES

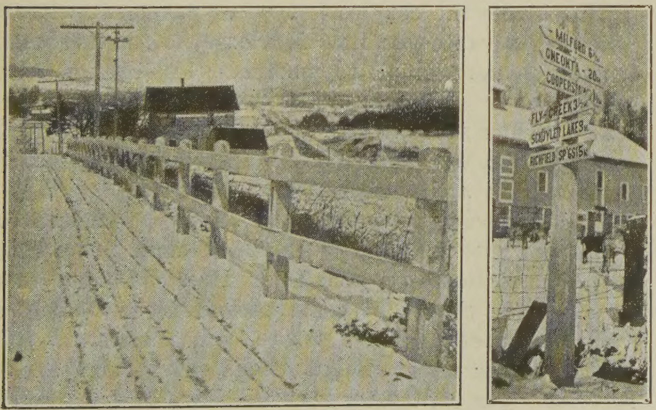
The cement was hauled on the job as needed from storage piles located at frequent intervals along the road. The water was pumped by two duplex pumps, one to each mixer, through 1½-in. pipe, which also provided water for sprinkling subgrade and finished concrete. At one place the water was pumped 9000 ft. against a 130-ft. head.

Wooden side forms, 2 x 5 in., were used, being held in place by steel pins. The forms were removed after about 24 hours. The finish of the concrete was obtained by screeding, no troweling or floating being required. The slightly roughened surface thus formed provided a better bond for the top course. Each morning the previous day's work was covered with about 1 in. of earth, which was kept moist for at least seven days, after which it was scraped off and the road opened to traffic.

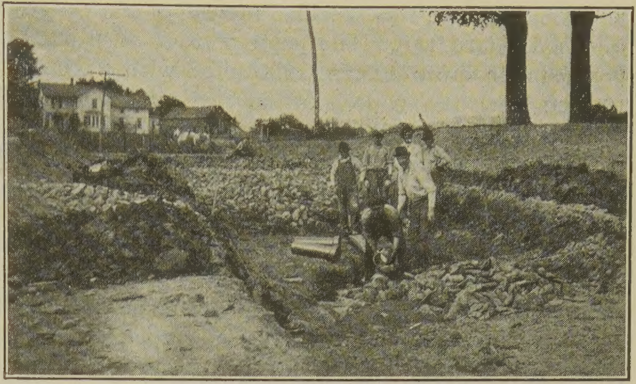
LABOR

About 30 men were employed at each mixer and were distributed as follows: 1 foreman; 2 or 3 operators and fireman (fireman sprinkled subgrade); 1 pump fireman; 2 handling cement (1 from wagon and 1 to mixer); 3 or 4 setting side forms, removing forms and sprinkling concrete; 2 trimming subgrade; 2 handling template; 3 leveling the concrete with shovels ahead of the template; 9 or 10 shoveling and wheeling stone, and 5 shoveling and wheeling sand.

The top-course specifications called for cleaning the concrete, after which high-carbon binder tar was applied at the rate of ½ gal. per square yard. The tar was heated to about 250 deg. Fahr. in the tank cars in which it was shipped, and applied at from 40 to 50 lb. pressure. The pressure distributor was hauled by a tractor, which also furnished steam to run the air-pressure pump. Immediately after applying the tar, ¾-in. stone was spread, only enough being used to keep the tar from picking up while being rolled. A 10-ton roller was then started, and the rolling and spreading continued together until about 1-in., loose measure, of ¾-in. stone was applied. Enough of this size stone was used so that no tar came to the surface, yet each stone was bedded in tar. A second application of tar, ½ gal. per square yard, was distributed as described, and this was covered at once with a thin layer of screenings. As before, the rolling and spreading of the stone were carried on simultaneously. It required about ¾ in., loose measure, of screenings to prevent the pavement from bleeding. In building this top course it was found that the first layer of stone could be rolled too much, forming a thin layer of dust to which it was hard to make the second coating of tar bind, but thorough rolling of the second application improved the pavement. With an average of 5 men sweeping and 15 men spreading stone, the progress was about 1500 lin. ft. of finished wearing course a day.



WOOD-CONCRETE GUARD RAIL AND SIX-SIDED GUIDE POST AND DIRECTION SIGNS



WHERE SPRINGS AND QUICKSAND WERE ENCOUNTERED TILE DRAINS COVERED WITH STONE WERE LAID

CRACKS

About ½ mile of top course was laid in the fall of 1915. On this stretch no cracks developed and the entire pavement wintered well. On the remaining concrete foundation transverse cracks showed up during the winter at an average of 50 ft. apart, some of the resulting slabs being over 100 ft. long, while others were only 20 ft. long. No expansion joints were provided during construction, but whenever the work was stopped for any length of time a vertical joint was placed and the concrete brought up to it. A slight change in design might have prevented some of the longitudinal cracks. The plans showed a crowned subgrade which should have been designed flat and thus the crown of the pavement would have made an increased thickness at the center, giving more strength at this weak plane. Before the top course was started all cracks were cleaned out their entire depth and poured flush with hot tar.

Several unusual structures were used in building this road. A special guard rail, having concrete posts and wooden rails, was specified instead of the customary all-wood guard rail. The posts were 7 ft. 3 in. long, 6 x 6 in. in cross-section, reinforced with a ⅜-in. deformed steel bar in each corner and were placed 3 ft. 6 in. in the ground. Wooden rails, 2 x 6 in., were bolted through the posts and painted three coats of white paint. At the rail joints 3-16-in. channeled plates, 18 in. long, were provided, to which the ends of the rails were bolted. The contract price for the guard railing, in place complete, was 45 cents per linear foot. The concrete posts, being practically permanent, eliminate the high maintenance expense of replacing wooden posts, which decay rapidly at the ground line.

GUIDE SIGNS

The guide signs were 1-in. pine boards, 3 ft. 4 in. long and 6 in. wide, having black enameled letters 4 in. high on a white background. One end of the sign was pointed to indicate the direction. Distances were given to the nearest ½ mile. These guide signs were fastened to six sided reinforced-concrete posts by means of T-bolts. The six sided posts, superseding the older design which was four-sided, were designed to fit better the different angles met with in intersecting highways. The contract price for the posts was $10 each and for the signs, in place complete, was $1 each.

Due to the scarcity of suitable cobbles for paving ditches of over 5 per cent grade, a 1:2:4 concrete gutter, 6 in. thick, was substituted. During construction it was found impracticable to smooth the concrete to the correct section with a template, so that the concrete, after being placed and roughly shaped, was covered with a light coating of mortar and then floated into the proper section. Vertical joints, with tarred paper between, were placed at 6 ft. intervals. To date no slabs are displaced or cracked, although about 1200 sq. yd. was placed during the late summer of 1915. The contract price was $1.04 per square yard, in place complete, not including the necessary excavation.

MATERIALS TESTED

All stone, sand, cement and tar were sampled before being shipped, and tested and passed on by the highway commission laboratories before being used on the job. In addition, field tests of sand were made covering each day's work. These tests were for per cent passing a No. 20 and a No. 50 sieve. There was also a loam determination. Twice during construction the sand was found to be unsatisfactory. The first time it was too fine and was corrected by mixing some coarse sand into what was delivered on the road; the second time there was an excess of loam, which fault was stopped by notifying the shippers that better washing would be required. For every 500 cu. yd. of concrete foundation placed, two 6-in. cubes were made. After being kept in moist sand for 21 days these cubes were shipped to the laboratories, and at the end of 28 days they were tested on a compression machine. The breaking strength of the 36 cubes on this road averaged 2344 lb. per square inch, which was well above the minimum required.

The total cost of the road, including culverts, excavation, and details, such as guard rails, gutter paving, etc., but exclusive of engineering, was $89,075.29 or $11,622.62 per mile. The cost of the pavement was as follows:

	Per Sq. Yd.
1:2½:5 concrete foundation, 5 in. thick	$0.708
Top course, including stone and tar, in place, complete	.2225
Total cost of pavement	$0.9305

For comparison there are listed below the average costs of several of the common types of pavement built in this section of New York State and compiled from data in the 1915 bulletin of the highway commission:

	Per Sq. Yd.
Waterbound macadam, 15 roads	$0.737
Waterbound macadam with hot or cold oil surfacing, 13 roads	.8103
Grouted bituminous macadam, 23 roads	.946
Concrete pavement, 27 roads	1.117
1:2½:5 concrete foundation with mixed bituminous macadam top course, 7 roads	1.335

It is readily seen from the foregoing table that in first cost the tar-macadam top course on a concrete foundation is nearly the same as the grouted bituminous macadam and considerably less than concrete pavement. In regard to these three competing types of medium-priced pavements, the composite type has many distinct advantages. Practically all failures of macadam roads can be traced to poor foundation. The stone of the lower courses sinks into any soft spots in the subgrade and the top course follows. This forms a pot hole which is a source of constant trouble and maintenance expense and makes a rough road for the traveling public. In a pavement with a concrete foundation, the concrete bridges over these weak points in the subgrade, thus eliminating one of the worst features of an all stone pavement.

Concrete pavement, while a type requiring little maintenance, is high in first cost, needs extra care in construction and in the choice of the materials used as ingredients, and is slippery and hard for horse traffic. No expansion joints are needed in the composite type of pavement, as the bituminous macadam mat keeps moisture and temperature conditions constant in the slab, thus protecting it from extreme changes resulting in cracking and displacement. Should the base crack, as it is not exposed to traffic, it requires no maintenance. The only maintenance necessary for this pavement, therefore, is to patch the wearing course as weak spots develop and to clean ditches and culverts. Possibly every three or four years a light oil should be applied to enliven the old bituminous material.

ADVANTAGES OF COMPOSITE PAVEMENT

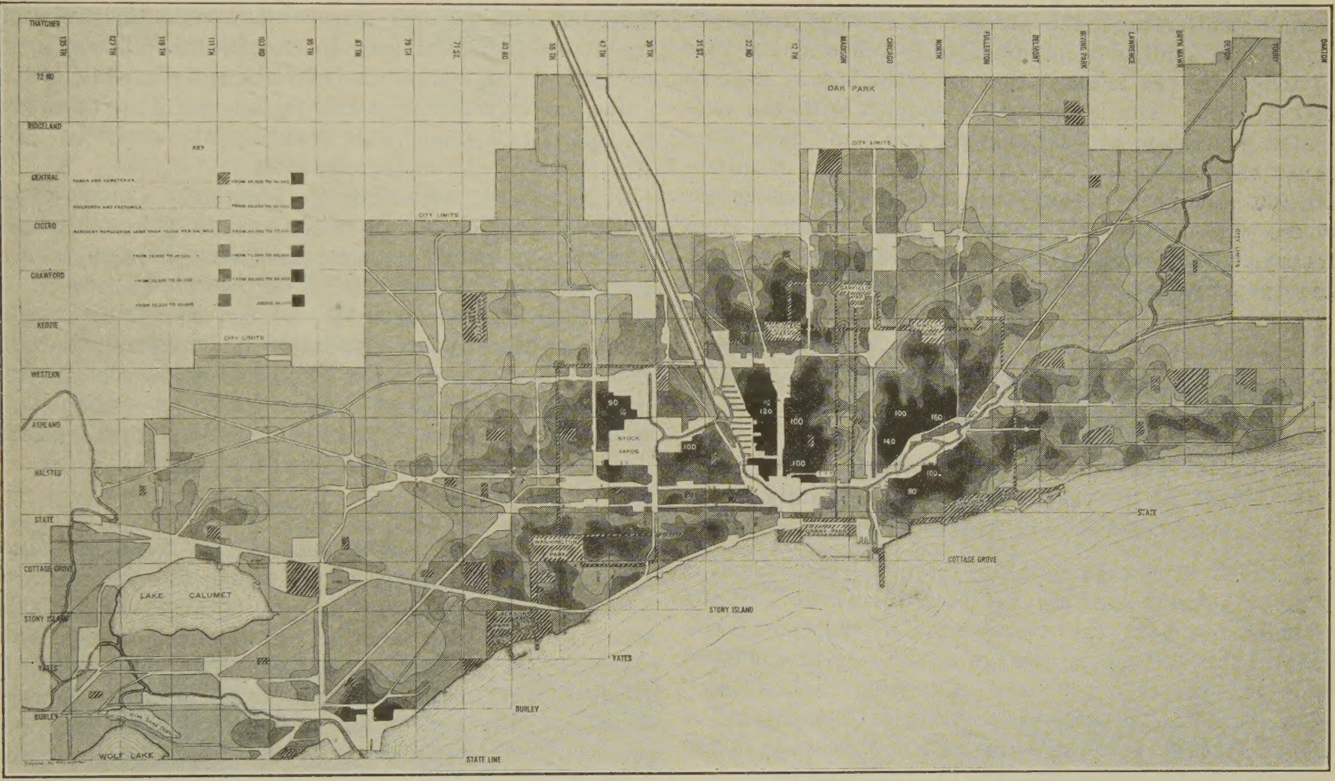
This leaves the composite type of pavement with the following advantages: Low first cost; low annual maintenance charge; simple to construct; less care in selecting the materials entering into its structure; permanent base on which to build any type of surfacing, should the original wear out, and smooth and resilient surface for automobilists and horsemen.

This highway was constructed under the supervision, plans and specifications of the New York State Highway Commission, of which H. E. Breed is deputy commissioner in charge of construction; H. E. Smith, division engineer, and A. T. Paine, county assistant. The writer was in direct charge of the engineering and inspection. The contractor was the Newport Construction Company of Herkimer, N. Y.

Chicago Will Have 5,000,000 Population in 1950

Traction and Subway Commission Makes Estimates of City Growth to Anticipate Transportation Needs and Earning Power

AS THE BASIS for estimating the gross earnings of the proposed consolidated traction system in Chicago in the future, and the number of passengers which the system will be expected to serve, the Chicago Traction and Subway Commission has made an elaborate study of the characteristics, growth and development of the city in so far as they have a direct bearing on its transportation problems. The main report of this study was abstracted in the Engineering Record of Dec. 23, 1916, page 770. The commissioners, William Barclay Parsons, Robert Ridgway and Bion J. Arnold, reached a general conclusion that it is reasonably safe to assume that Chicago's growth will continue at a rate which will realize a population of not less than 5,000,000 persons by the year 1950.



CONTOUR MAP MARKS ZONES OF DENSITY OF CHICAGO'S POPULATION

DISTRIBUTION OF PRESENT POPULATION

The manner in which the present population of Chicago is distributed over the city area, which has a material bearing on the possibilities of any transportation plan, is illustrated in a density contour map shown herewith. The most densely settled districts are seen to be located between the north and south branches of the Chicago River and Western Avenue. Within this area the population reaches a maximum density of 165,000 persons per square mile (250 per acre) for a few city blocks. About half of the mentioned area shows a density of 100,000 per square mile or over. Only two other small sections of the city are as densely populated as this one—one located adjacent to the Stock Yards and the other north of the Loop district between Wells Street and Halsted Street and Chicago Avenue and North Avenue.

These heavily populated districts, however, are not so dense as those in some other cities—notably the East Side of New York, which has 410,000 persons per square mile, or 640 per acre, and certain blocks reaching a maximum of more than 1000 per acre. The average number of persons per square mile in Chicago is 12,787, or 20 per acre, while that of Manhattan Island, New York City, is 105,000 per square mile, or 164 per acre—more than eight times as great. A comparison of ten of the largest American cities for the year 1910 indicates that while Chicago is second in population it is only seventh in density.

The rapid spreading out of the population of Chicago, or the low density per unit area, is attributed to the level nature of the topography of the city and the ease with which sections can be opened up for building purposes, together with certain provisions in the building laws which practically limit the economic height of apartment buildings. The construction of surface and elevated lines, which have constantly reached out into new territory, has also stimulated the outward movement of population. An important fact in this connection is that since 1900 the inlying district bounded by Twenty-second Street, Halsted Street and Chicago Avenue has recorded a decrease in residential population.

The analysis of Chicago's population brings out the fact that the low average density of twenty persons per acre for the whole city area is largely due to the wide distribution of its principal residential districts, lack of uniform building in these districts and the large areas still undeveloped. This separation of the residential population into many districts and the relatively low average density of the areas tributary to practicable transit routes promise a volume of traffic sufficient to support certain high-speed elevated lines at the present time, but insufficient to support corresponding subways, with their much greater cost, until development has proceeded further.

REVENUE RIDES EXPECTED IN 1950

With the increase in population estimated through the year 1950, the commission attempts to derive from this the number of total revenue rides which may be expected. Any increase in traction gross receipts depends on a growth in population, an increase in rides per capita or both. The riding habit, or number of rides per capita per annum, the report proceeds, varies with the size of cities, but has a general upward tendency with increases of population and increases in city area.

In the financial plan, presented in another part of the commission's report, the number of revenue rides per capita was arbitrarily assumed to increase at the rate of two rides per annum; that is, from 334 in 1917 to 400 in 1950. The latter figure, coupled with the estimated population of 5,000,000 for the same date, warrants the estimate of a passenger revenue of $100,000,000 and gross receipts of $104,500,000, which includes such additional income as other revenue from transportation, revenue from other railway operations, non-operating income and profit-and-loss credits.

Brush Used Successfully in Toronto Trickling Filter

Distribution of Sewage Over the Surface Does Not Need to Be Very Uniform—Especially Adapted Where Stone Is Scarce

A TYPE of sewage trickling filter in which brush is the filtering medium has been in use at Toronto, Canada, for more than two years. At the end of two months it was treating sewage at the rate of 6,000,000 imp. gal. per acre per day. According to Lieut.-Col. G. G. Nasmith, director of laboratories, Department of Public Health, Toronto, in an article appearing in the *Journal* of the Royal Sanitary Institute for December, and from which these notes are taken, a very high degree of nitrification has been obtained; the effluent has been uniformly stable, and the installation, it is stated, is a decided success.

After numerous experiments with laths and other material that would provide a freer circulation of air than the usual type of filter, and also increase the amount of surface on which the bacterial slime could accumulate, it was decided to use bundles of brush for the filtering material, in the hope that a greater quantity of sewage could thereby be oxidized in a given time. Accordingly, the stone was removed from an existing trickling filter and replaced by brushwood, which was cut and made into bundles by means of a box press. The bundles were then placed in the filter, care being taken to leave a 1-ft. space between the brush bundles and the wall and also a small space in the center in order to allow air to enter freely from the sides. A revolving distributing sprinkler, which had been used in connection with the stone filter, was placed in operation, with the result that the brush quickly became matured.

In an article by George Phelps, engineer in charge of North Toronto sewers and disposal works, which appeared in the Feb. 8 number of the *Canadian Engineer*, it is stated that the filter, 50 ft. in diameter, was filled to a depth of 5½ ft., which later settled to a depth of 4½ ft., but that the shrinkage apparently stopped at the end of 18 months. No signs of the rotting out or breaking down of the brushwood are as yet in evidence. The cost of placing the brushwood in the filter, which also includes cutting, bundling and hauling about ½ mile, was $1.20 per cubic yard. Witchhazel was found to bundle most easily; but nearly every kind of wood is suitable provided it is green and cut at a time when there are no leaves. It is further noted that the sewage passes through a coarse screen, detritus tanks and sedimentation tanks with a 3-hour detention period before reaching the filter, which, it is claimed, now receives 7,250,000 imp. gal. per acre per day, with the probability of an increased rate in the future. The effluent contains 0.1 to 0.2 cu. cm. of sediment per liter, but is a fine humus which is settled by one-half-hour retention in tanks, and indicates a stability of nearly 10 days when tested with methylene blue.

It is hoped, according to Lieutenant-Colonel Nasmith, that the cheapness of the system will enable communities to install systems of sewage disposal in districts where the high cost of the accepted types of installation has been prohibitive. A suggestion is made, as far as the cost of installation is concerned, that the brush filter would solve the problem in the prairie provinces of Canada or similar localities, where stone would in many cases have to be hauled by train for hundreds of miles, with a high resultant cost.

ADVANTAGES OF BRUSH MEDIA

In conclusion, Lieutenant-Colonel Nasmith summarized the advantages of the brush filter as follows: (1) Brush is cheap, and may be obtained almost anywhere; (2) skilled labor is not required in construction; (3) it does not sludge; the slime will frequently become quite thin after heavy rains when the sewage is diluted, though the efficiency of the filter is unimpaired; (4) the brush may at any time be removed and burned; (5) it is durable; a filter has now been in operation for more than two years without showing any signs of decay; (6) the distribution of the sewage over the surface of the filter does not need to be very uniform; the general tendency is to redistribute itself in the filter meshwork; (7) it gives the maximum amount of surface, with a freer circulation of air in a unit volume of space; (8) it has proved to be a success when treating the sedimented sewage of a city on a large scale, and has treated three times as much sewage to the acre as the standard stone filter will treat.

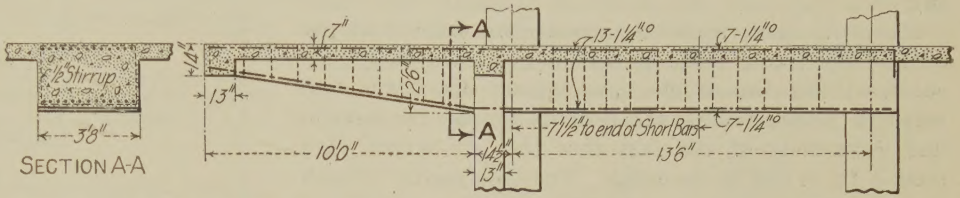
In Locating Military Roads, Remember—

While highways intended primarily for military purposes should be located near our boundaries, they must not be so near that they can be easily raided or captured by small bodies of the enemy and thus likely to be of use only to him and not to us.

Concrete Cantilever Beams Support Island Hotel Entranceway

Flat-Slab Floors Without Column Capitals Facilitate Arrangement of Partitions in Eight-Story Building at Aurora, Ill.

CANTILEVER beams of reinforced concrete, designed to support an outside entranceway leading from a bridge over the Fox River, and flat-slab floors without column capitals, to facilitate the placing of partitions, are two principal features in the recently completed eight-story Island Hotel at Aurora, Ill. Square columns were adopted, and the four-way system of slab reinforcement was used. Above the cantilever entranceway for three panels of its length the mezzanine floor was also extended over the river on columns supported by the cantilever beams, the heaviest of which is here illustrated in detail.



DETAILS OF THE HEAVY CANTILEVER BEAMS SUPPORTING TWO-STORY PART OF STRUCTURE

This modern fire-resistive type of hotel was constructed on an island in Fox River next to the site of a new bridge. The building is 70x100 ft. in plan, with its main entrance on the south side and with a second entrance at the northwest corner, where the hotel adjoins the new bridge. This outside entrance, which is indicated by the photographs, cantilevers 10 ft. over the river, and results in saving space within the building lines to such an extent that one more store is now available which would have been eliminated if this scheme had not been adopted.

After deciding to adopt the cantilever entranceway it occurred to the designers that a ladies' parlor opening on the mezzanine floor could be located above it as an attractive and economical feature. This two-story part of the cantilever was made three panels long, as illustrated in one of the photographs. The main panel lengths are relatively short, the square columns in the building being spaced about 14 ft. apart.

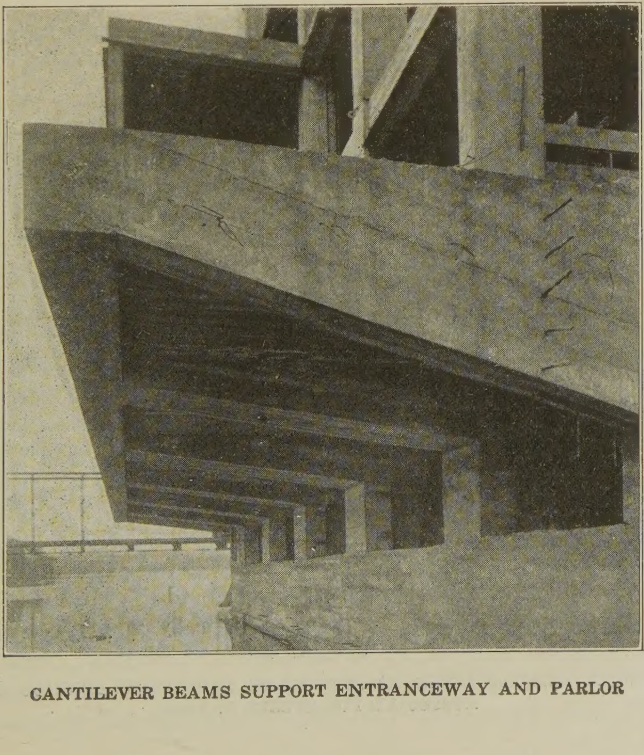
The detail drawing of the heaviest cantilever beams, all of which are made continuous over one interior panel to prevent excessive bending in the exterior columns, indicates the heavy reinforcement used in both top and bottom flanges. This steel was required for resisting negative moment over the column when the cantilever was fully loaded.

FLAT-SLAB FLOORS

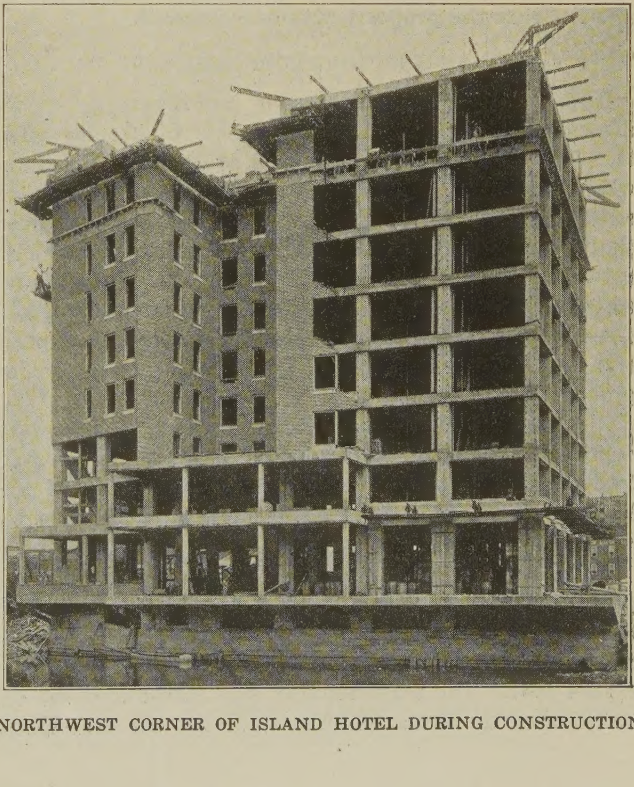
In order to facilitate the locating and rearranging of partitions, flat-slab floors supported on square columns designed to eliminate the column capitals usually used were adopted. The first-floor slab is 7 in. thick; the slabs used on the upper floors are 6 in. thick. No beams were required except the cantilevers already described and beams for window lintels and to frame around elevator and stair openings. The design of the slabs proved to be economical, four-way reinforcement of ¼-in. rods being used.

The forms for the cantilever beams were also constructed as a cantilever timber framework, owing to the fact that the river bottom beneath the outer ends of these cantilevers consists of boulders, dirt and rubbish, making it impossible to drive piling on the shore.

The structural design was made by the Concrete Steel Products Company, of Chicago. H. Z. Dietz, of St. Louis, was the architect. The contractor was the Caldwell-Marshall Company, of Aurora.



CANTILEVER BEAMS SUPPORT ENTRANCEWAY AND PARLOR



NORTHWEST CORNER OF ISLAND HOTEL DURING CONSTRUCTION

How Davenport Proportions Paving-Assessment Benefits

Method Devised to Eliminate Unfairness of the Front-Foot Rule as a Basis for Computing Taxes

By ROSCOE E. SAWISTOWSKY
City Engineer, Davenport, Iowa

ALL paving assessments in Davenport, Iowa, previous to January, 1915, were made in accordance with the front-foot rule, the code reading as follows: "The cost of making or reconstructing any street improvement . . . shall be assessed as a special tax against the property abutting thereon in proportion to the number of linear front feet of each parcel so abutting."

Except in cases where the assessment exceeds 25 per cent of the actual value of the lot as shown on the assessment roll, the courts have upheld the "front-foot rule" in proportioning the benefits among the several lots, regardless of the fact that the lots might vary from 1 ft. to 300 ft. in depth. The code reads: "Such assessments shall not exceed 25 per centum of the actual value of the lot or tract at the time of levy, and the last preceding assessment roll shall be taken as prima-facie evidence of such value."

In spreading the assessment on the lots abutting on the street being improved, the benefits were determined as being proportional to the frontage on such improvement, disregarding whether or not the assessment exceeded one-quarter of the actual value of the lot or tract. The property owners considering themselves overassessed had the privilege of objecting and filing a petition with the City Council asking that their assessment be reduced. Before the petition is acted upon the first installment must be paid by the objector; then if the council decides that the property has been assessed in excess of 25 per cent of the actual value thereof, it rebates, by resolution, from the improvement fund the amount that the property was overassessed.

NON-ABUTTING LOTS ASSESSED

The state legislature passed a law regarding special assessments for street improvements to become effective Jan. 1, 1914, under which we are now working, and which states, in substance, that the amount to be assessed against private property, on the basis of area, shall "include one-half of the privately owned property between the street improved and the next street, whether such privately owned property abut upon said street or not, but in no case shall privately owned property situated more than 300 ft. from the street so improved be so assessed.

"In case of improvement upon an alley, such assessment shall be confined according to area to privately owned property within the block or blocks improved, and if not platted into blocks, for not more than 150 ft. from such improved alley."

The intent of the code is enigmatical and does not give any suggestion as to how the benefits are to be arrived at. From reading, one would judge that the area assessable should all be assessed at a uniform rate per square foot. The state senator who introduced the bill stated that the intention was to lessen the assessment on corner lots; that they should not stand the total cost of paving on both sides as under the old front-foot rule, but that properties back to the center of the block should help pay toward the cost of the improvement, as they were benefited to a degree by having the street paved, although they do not abut directly on such improvement.

HOW NEW METHOD WORKS

Fig. 1, "Plat of Street Improvement," shows this method of assessing for street paving. The property to be assessed in each block is shown by the dotted lines and includes one-half the privately owned property.

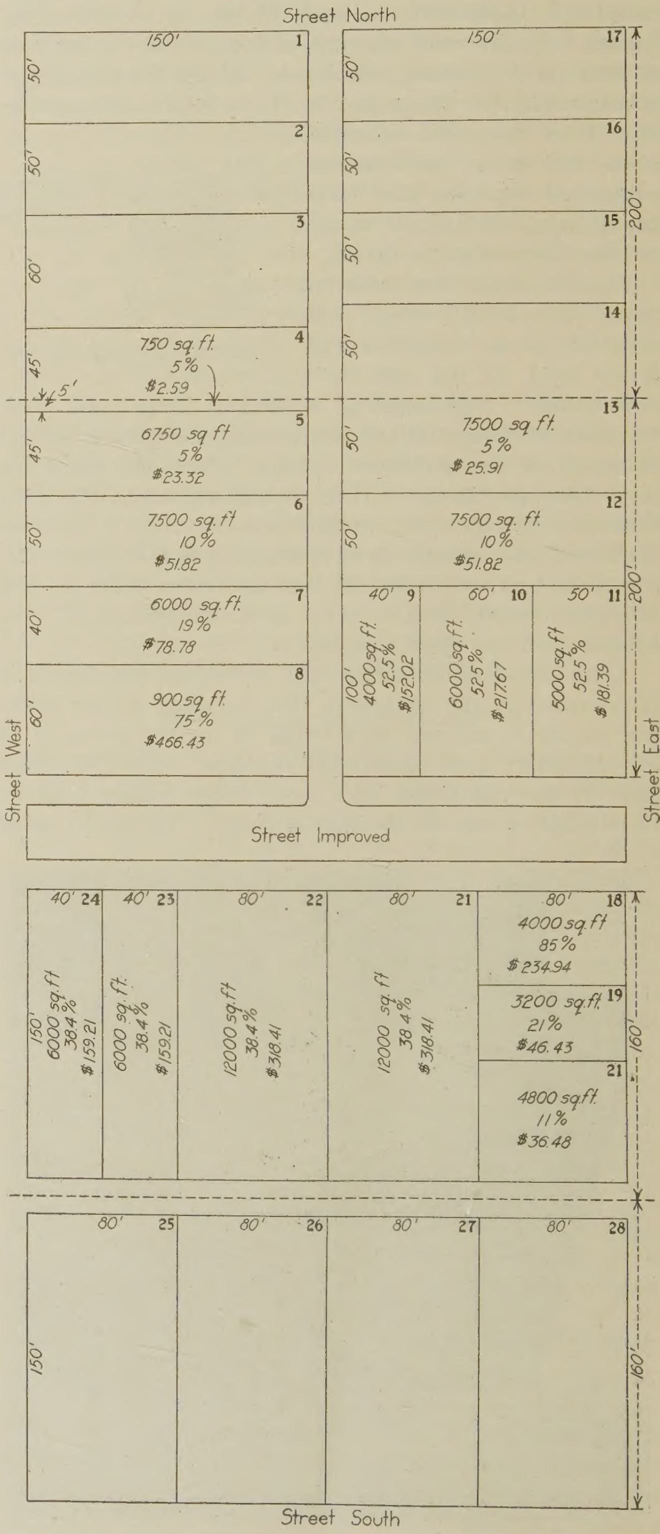


FIG. 1—PLAT OF STREET IMPROVEMENT, INDICATING METHOD OF ASSESSING FOR STREET PAVING

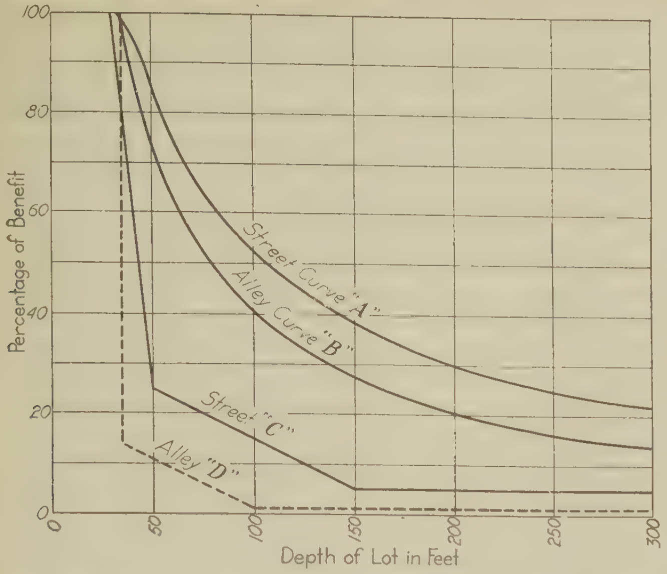


FIG. 2—CHART FOR GRADUATING BENEFITS FOR LOTS OF DIFFERENT DEPTHS, ABUTTING AND NOT ABUTTING ON STREET BEING PAVED

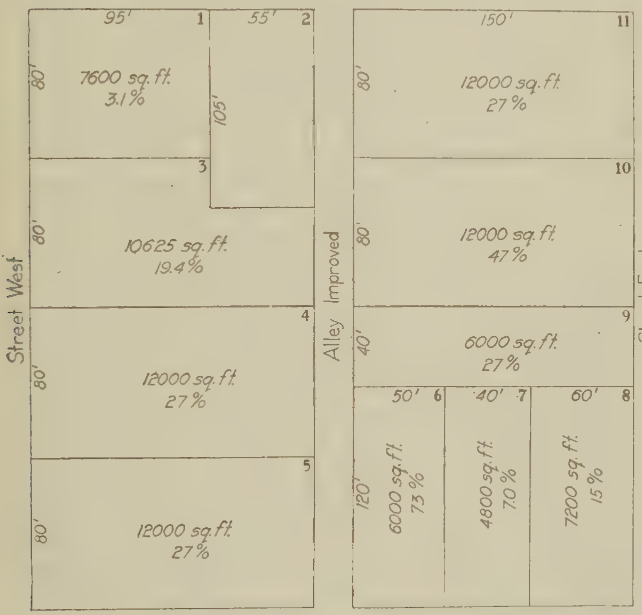


FIG. 3—PLAT OF ALLEY IMPROVEMENT

Granted that the property not abutting directly on the street improved is not benefited nearly as much as a lot fronting on the improvement, it remained to adopt a fair and equitable method of grading or proportioning the benefits that would meet with general approval.

We designed a chart, or curve, Fig. 2, for graduating the benefits for lots of different depths abutting and not abutting on the street being paved, no matter which way they are cut up. The area for the first 30-ft. zone pays at the rate of 100 per cent of its area; the next 20 ft., 62½ per cent; the next 20 ft., 23 per cent; the next 20 ft., 19 per cent; the next 20 ft., 15 per cent; the next 20 ft., 11 per cent; the next 20 ft., 7 per cent; and the next 150 ft., 5 per cent.

To find the rate for a lot abutting on the street improved, obtain the rate directly from Curve A, Fig. 2. Example—Lot 18 (see Fig. 1, plat of street improvement), which has a depth of 50 ft., pays at the rate of 85 per cent of its area. Lot 9, with a depth of 100 ft., pays at the rate of 52.5 per cent of its area. Lot 24, with a depth of 150 ft., pays at the rate of 38.4 per cent of its area.

For a lot not abutting directly on the street improved read on Curve C, Fig. 2. Example—Lot 7: The south and north lines of Lot 7 are removed 60 and 100 ft. respectively from street improved. On Curve C the rate for 60 ft. is 23 per cent and for 100 ft. 15 per cent. The area of Lot 7 pays at the rate of 19 per cent, or the average between 23 and 15 per cent.

Lot 6 pays at the rate of 10 per cent of its area, and all the area in the zone between lines 150 and 300 ft. distant from the line of the street improved pays at the rate of 5 per cent.

After determining all the lot rates the "rate product" is obtained by multiplying the area by the rate. The total cost of paving the street is then divided by the total rate products to obtain the cost per unit rate product. The accompanying table gives the assessment:

AMOUNT OF ASSESSMENT FOR DIFFERENT LOTS

Lot No.	Area of lot	Rate, per cent	Rate product	Assessment
4........	750	5	37.5	$2.59
5........	6,750	5	337.5	23.32
6........	7,500	10	750.0	51.82
7........	6,000	19	1140.0	78.78
8........	9,000	75	6750.0	466.43
9........	4,000	52.5	2200.0	152.02
10........	6,000	52.5	3150.0	217.67
11........	5,000	52.5	2625.0	181.39
12........	7,500	10	750.0	51.82
13........	7,500	5	375.0	25.91
18........	4,000	85	3400.0	234.94
19........	3,200	21	672.0	46.43
20........	4,800	11	528.0	36.48
21........	12,000	38.4	4608.0	318.41
22........	12,000	38.4	4608.0	318.41
23........	6,000	38.4	2304.0	159.21
24........	6,000	38.4	2304.0	159.21

Practically the same method is used to determine the benefits on alley paving, except that the percentage of benefits drops off more sharply the farther the area is removed from the improvement.

The area in the first 35-ft. zone abutting on the improvement pays at the rate of 100 per cent; the next 35-ft. zone at the rate of 10.5 per cent; the next 30-ft. zone at the rate of 4 per cent, and the remaining 200 ft. at the rate of 1 per cent.

To obtain the rate for Lot 11 (see Fig. 3, plat of alley improvement) the percentage of benefits on alley Curve B (Fig. 2) for 150 ft. is 27 per cent. For a lot not abutting obtain the per cent from Curve D. For example, Lot 7 would be 7 per cent, the average between 11 and 3 per cent, the rates respectively for the distances that the west and east lines of Lot 7 are removed from the alley improved.

Motor-Truck Legislation and Maintenance Essential for Gravel Roads

Iowa has experimented with gravel roads for the last few years. If there is any one lesson of more importance than another to be drawn from the experimental road work during the 1916 season, according to the *Service Bulletin* of the Highway Department, it is that a consistent patrol maintenance is absolutely essential for the upkeep of a gravel road surface. This is true whether the gravel surface is oiled or unoiled. A second lesson to be drawn is that if Iowa is to have surfaced roadways of any type now in common use, it will be absolutely necessary to have some regulation as to the use of these surfaced roadways by heavy trucks and tractors with cleats on their wheels.

Operate Continuous-Flow Activated-Sludge Plant

Prof. Edward Bartow Gives the Results of Experiments Utilizing a Former Septic Tank at Champaign, Ill.

IF THE SLUDGE can be dewatered economically the activated-sludge process can be operated successfully, is the conclusion pointed out by experiments on a converted municipal septic tank at Champaign, Ill. The results of these experiments were given recently before the Western Society of Engineers in a paper by Prof. Edward Bartow, F. W. Mohlman and J. F. Schnellbach.

The septic tank designed by Prof. A. N. Talbot in 1897 for the city of Champaign was reconstructed early in 1916 with the expectation that 200,000 gal. of domestic sewage could be treated daily. The plant contains a screen chamber and pumping pit, grit chamber, aërating chamber, settling chamber, blower room, and laboratory containing the sludge-drying apparatus. A sludge-drying bed and a pond into which the effluent from the process may be discharged are also provided.

DETAILS OF PLANT

The sewage is drawn from the main outlet sewer of the city of Champaign. The daily flow is estimated to be from 1,000,000 to 1,500,000 gal. of sewage, though in wet weather, owing to seepage into the sewers, the amount of flow is greatly increased. A screen with vertical bars spaced with ¾-in. openings prevents coarse material from reaching the pumps. The grit chamber is 34 ft. long, and has two compartments, each 1 ft. wide. The sewage flows from the grit chamber into the aëration chamber, a rectangular concrete tank 17x36½ ft. in plan and 9½ ft. deep, having a capacity, after allowances are made for baffle walls and sloping bottom, of about 36,000 gal. The chamber is divided longitudinally by three baffles into four compartments, through which the sewage flows a distance of about 140 ft. The lower part of each compartment has sides sloping toward the center to a channel 12½ in. wide and 4 in. deep and extending the length of the compartment.

Above this channel filtros plates are supported on T-bars embedded in the concrete. The channel below the filtros plates was divided into sections for six filtros plates each, with the expectation that each set of plates would be separated from all the others and that the supply of air to each set could be regulated by an air pipe and valve. Owing to the porosity of the sloping concrete sides, it was impossible to regulate independently each set of plates.

The aëration tank was calculated to be able to treat 144,000 gal. of sewage and sludge daily if aërated during a period of 6 hours, 170,000 gal. if aërated 5 hours, and 216,000 gal. if aërated 4 hours.

SETTLING CHAMBER

The settling chamber is 6x10½ ft. in plan and 11 ft. at its lowest point, having a capacity of 3700 gal. If the flow passed through all the tank it would have a retention period of 24, 31 and 37 minutes, with a flow through the aëration chamber of 4, 5 and 6 hours respectively. In order to assist the settling of the sludge the liquid is passed down into the center and up around the edge of a hollow frustrum of a pyramid in the center of the settling basin. The frustrum of the pyramid is 15 in. square at the top, and 3 ft. square at the bottom, and it extends to within 5 ft. of the bottom of the chamber. From the settling tank the effluent flows over a weir and is either returned to the sewer or discharged into a pond formed by two dams thrown across the abandoned bed of a stream. It covers about 0.1 acre and its maximum depth is 3 ft.

The sludge is withdrawn from the settling chamber by an air lift and can be discharged into the raw sewage, where it enters the aëration chamber, or diverted for experimental purposes, or discharged into the sewer. Air is supplied for aëration and for the air lift by a rotary positive-pressure blower having a rated capacity of 300 cu. ft. per minute, driven by a 15-hp. electric motor. The air is passed through cheesecloth, spread over a box having sides of wire netting, before it enters the blower suction pipe. The air is measured through a Venturi meter.

CAREFUL CONCRETE WORK ESSENTIAL

The plant was put in operation May 25, 1916; but since there was an escape of air along the sides of the baffle walls the plant was operated only until June 11, when it was shut down for repairs. The holes resulted from faulty concrete work and from the difficulty in making a tight joint between old and new cement. The holes were satisfactorily filled. This difficulty should, Professor Bartow pointed out, emphasize the fact that very careful concrete work is essential if the plates are to be set above concrete. Cast-iron or metal frames as used at Milwaukee and Cleveland may be found preferable.

Modifications in the manner of operation were made at intervals in an attempt to determine the method of obtaining the highest efficiency. The time of operation was therefore divided into periods, and average results were determined for each period shown in the table.

Operation was most successful during the periods of Sept. 19 to 22 and Oct. 14 to 22, in which 2 cu. ft. of air per gallon of sewage was used to obtain stable effluents. This amount is higher than the amount required in the experiments in the fill-and-draw tanks. It is probable that some air escaped from the concrete

RESULTS OF OPERATION AND CONTROL OF CHAMPAIGN ACTIVATED-SLUDGE PLANT

Date, inclusive 1916	Rate of flow, gal. per day	Air, cu. ft. per gal.	Per cent sludge Aërating basin	Per cent sludge Air lift	Decolorization, methylene blue, hours	Relative stability of effluent
July 11-29	110,500	2.2	12	..	20	33
July 30-Aug. 15..	81,700	2.7	15	67	50	64
Aug. 16-Sept. 5..	61,100	2.9	24	51	90	90
Sept. 6-12	69,100	2.1	23	48	38	55
Sept. 13-18	82,200	2.3	22	45	105	96
Sept. 19-22	130,000	2.0	16	31	100	95
Sept. 23-28	177.600	1.6	13	26	35	52
Sept. 29	92,700	3.1	18	47	42	62
Sept. 30-Oct. 13..	143,200	2.0	19	38	41	59
Oct. 14-22	152,300	2.0	23	48	60	74

Plant shut down Sept. 29 from 10 a.m. to 7 p.m.

channels without passing through the sewage, and for this reason better efficiency might be obtained with a more satisfactory installation for air distribution. The settling tank was too small and the insufficient slope of the bottom (45 deg.) caused some sludge to be retained.

MAKE RETENTION-PERIOD TESTS

The actual period of flow through the settling tank was considerably shorter than the theoretical period. To find the actual retention period 5 lb. of salt and 20 grams of fluorescein in solution were added at the top of the frustrum of a pyramid in the settling chamber. The fluorescein was detected in the effluent in 10 minutes. The salt was at its maximum in the effluent in 15 minutes, and the quantity began to decrease in 20 minutes. The rate of pumping on the day of the test was 133,900 gal. The capacity of the settling basin would give a theoretical retention period of 34 minutes, and the actual retention period was found to be less than 20 minutes. The error in calculating the necessary retention period was due to calculations made from the fill-and-draw tanks, where satisfactory settling was obtained after 30 minutes of rest. In vertical-flow settling tanks the velocity of flow must be less than 8 ft. per hour, in order not to carry the sludge away. The possibility of settling the sludge in a second tank before it is pumped back to the sewage might prove practicable.

TRY NEW PRESS

Since drying on sand beds and centrifuging were being carefully tried at Cleveland, while the Berrigan press, made by the Worthington Company, and the press of the Simplex Ejector Company were being tried at Milwaukee, it was planned to use another method at Champaign. Through the courtesy of the Koering Cyaniding Process Company of Detroit a rotary press was furnished, such as has been used satisfactorily in filtering slimes in extracting gold and silver by the cyaniding process. This apparatus consists of a cylinder of filtros plates supported on a perforated steel cylinder outside of which, at a distance of about 1 in., is a solid-steel outer shell. The material to be filtered is forced into the interior of the cylinder of filtros plates. The cylinder is revolved and a cake of sludge built up on the inside of the filtros plates. The liquid filters through the plates into the space between the inner and the outer shell and is drawn off through outlets in the outer shell. Air pressure can be exerted from the interior to dry the cake and from the exterior to loosen it. The plates can be cleaned by back-flushing with water.

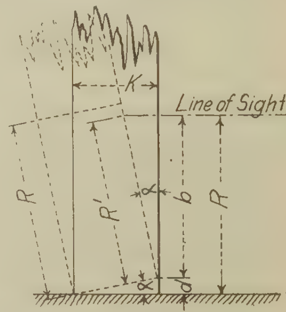
This company has also installed an apparatus for concentrating the sludge before its application to the rotary press. This concentrator consists of a cast-iron box 2 ft. square and 4½ ft. deep, inside measurements, lined with filtros plates. On the outside of the filtros plates are four independent compartments, through which the filtrate may be withdrawn or into which air or water may be forced for cleaning the plates. It is expected that the liquid sludge may be considerably concentrated in this apparatus so that the capacity of the rotary press may be greatly increased.

Swaying of Level Rod Causes Errors in Readings

Figures Given to Show Why Common Practice Adopted for Accuracy Should Be Prohibited

By S. GROMAN
Brooklyn, N. Y.

DISCUSSION frequently arises among engineers as to the advisability of swaying the rod in accurate leveling. It is to form an accurate means on which to base a decision on this matter that the following analysis is undertaken. When the rod is held on a flat surface in a vertical position, the true reading is obtained. If it is tilted forward the reading on the rod increases. When tilted backward, however, the reading obtained is not always greater than the true reading, due to the fact that the rod is rotating about the back or heel of the rod instead of a point in the same plane with the face of the rod, as shown in the drawing. R is the true rod reading when the rod is held plum; R^1, the rod reading when inclined backward at an angle α with the horizontal. K is the distance from face of rod to heel of rod.



WHAT HAPPENS WHEN LEVEL ROD IS SWAYED

ERRORS ANALYZED

To get the error produced by tilting the rod we must obtain the minimum value of R^1, for it is the usual practice when swaying the rod to take the smallest reading. This would be true if the rod were a plane surface. From the figure it can be seen that $d = K \sin \alpha$, and $b = R - d = (R^1 \cos \alpha) \therefore R^1 = (R - d)/\cos \alpha = (R - K \sin \alpha)/\cos \alpha$.

To obtain the minimum value of R^1 we take the derivative of R^1 with respect to α, which derivative when placed equal to zero will give us the angle at which R^1 is a minimum.

$$\frac{dR^1}{d\alpha} = \frac{[\cos\alpha(-K\cos\alpha)] - [(R - K\sin\alpha)(-\sin\alpha)]}{\cos^2\alpha} = 0$$

or $[\cos \alpha(- K \cos \alpha)] + [(R - K \sin \alpha) \sin \alpha] = 0$

or $-K \cos^2 \alpha + R \sin \alpha - K \sin^2 \alpha = 0$

or $-K(\sin^2 \alpha + \cos^2 \alpha) + R \sin \alpha = 0$

or $-K + R \sin \alpha = 0$

or $\sin \alpha = K/R$

Therefore the sine of the angle at which R^1 is a minimum is K/R. Substituting this value of sine α in the general formula for R^1 we will have the minimum value of R^1 for any true rod reading R in terms of K and R. Calling this $R^1{}_m$,

$$R^1{}_m = \frac{R - K \sin \alpha}{\cos \alpha} = \frac{R - K\frac{K}{R}}{\sqrt{1 - \frac{K^2}{R^2}}} = \frac{\sqrt{1 - \frac{K^2}{R^2}}\left(R - \frac{K^2}{R}\right)}{1 - \frac{K^2}{R^2}}$$

$$\text{or } R^1{}_m = \sqrt{\frac{R^2 - K^2}{R^2}} \times \frac{R^2 - K^2}{R} \times \frac{R^2}{R^2 - K^2} = \sqrt{R^2 - K^2}$$

Having the formula $R^1_m = \sqrt{R^2 - K^2}$, we are now able to find the error produced by backward tilting of the rod since the error is $(R - R^1_m) = E$. The usual thickness of a Philadelphia rod at the shoe is about 1½ in. = 0.125 ft. Since the face of the rod is set in about 0.01 ft., the effective thickness of the rod, $K = 0.115$ ft. With this value for K the value of $(R - R^1_m)$ for different readings is as shown below:

R in feet	E in feet	R in feet	E in feet
0.5000	0.0134	5.0000	0.0013
1.0000	0.0066	6.0000	0.0011
2.0000	0.0033	7.0000	0.0009
3.0000	0.0022	8.0000	0.0008
4.0000	0.0017		

SWAYING SHOULD BE PROHIBITED

As can be seen from the foregoing results, the error produced in a small-rod reading is so great as to make it absolute folly to sway the rod on a flat surface. Even when the rod is held on a point there is an error produced in swaying the rod, the effective distance K now becoming one-half its former value. This for all practical purposes cuts the error in half, but it still is large for readings up to 3 ft. Furthermore, it is an error which may be eliminated, and in accurate leveling the swaying of the rod should be prohibited. It may be stated that the elevations will not be affected by the same amount as the rod readings, for if the reading is too low on both foresight and backsight the error will be partly compensated. Indeed if the rod read the same on foresight as on backsight there would be no error introduced in the final elevation. However, such a condition does not exist in practice. If a bubble is attached to the rod the rod will be held plumb and leveling can be done quickly and accurately.

Oregon to Vote on $6,000,000 Road Bonds

Legislation Also Passed Simplifying Existing Road Laws, Creating State Highway Engineer and Regulating Motor Vehicles

THE OREGON LEGISLATURE which has just adjourned has provided for submission to the voters, at a special election to be held June 4, 1917, a $6,000,000 bond issue to be used in constructing a system of state highways. It is proposed to meet the interest and refund the principal by doubling the motor-vehicle tax. In addition, the legislature has provided for the issuance of $1,900,000 of road bonds in the event that revenues from established sources are not sufficient to match the federal-aid appropriations. Administration of the funds and construction of the highways will be under the supervision of the state highway commission and the state highway engineer.

NEW CODE ANNULS OBSOLETE PROVISIONS

A notable improvement in the new road laws of the state has been the annulment of many obsolete and conflicting provisions by the adoption of a new code, one section of which provides standard methods for opening, laying out and vacating highways. Heretofore three different processes have been available, which promoted more uncertainty and confusion than good highways. Another section regulates the expenditures of county funds and the administration of county work, doing away with the present supervisor system and providing for the appointment of a county roadmaster. This will effect a centralization of authority and will eliminate the haphazard and expensive system previously in force.

OFFICE OF HIGHWAY ENGINEER CREATED

Still another measure is known as the "State Highway Code," which provides a procedure for the construction of hard-surfaced highways and for the co-operation of county and State in construction of state highways. It provides also for the appointment by the governor of a non-salaried highway commission of three, which appoints the highway engineer, at a salary of $5,000 a year.

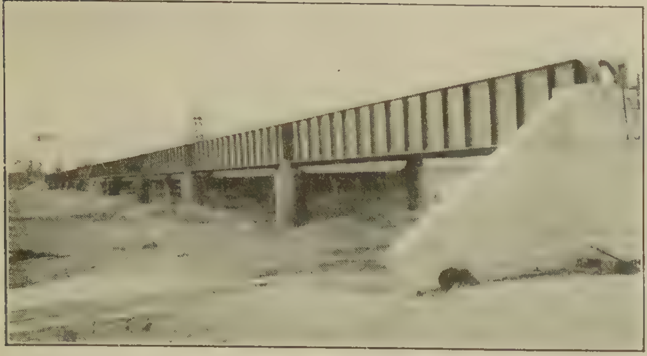
A measure to regulate motor vehicles was also passed at this session. The present motor-vehicle-license tax is doubled, and the entire proceeds are to be devoted to road work under the supervision of the state highway commission. The old law required that motor-vehicle-license fees be apportioned to the counties in which they were collected, after paying for license tags and other incidentals of state administration. The money was thus scattered, and inefficiently expended in many instances. On the basis of the existing number of vehicles in Oregon about $300,000 a year will be paid into the state-road fund from this source.

The foregoing information was obtained from Roy A. Klein, highway engineer, Portland, Ore.

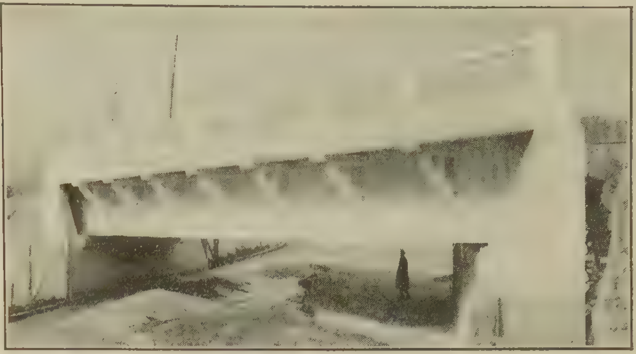
Rules for the Harvesting of Ice

That no epidemics in communicable diseases caused by pollution in ice have been discovered in Minnesota is the conclusion drawn from investigations undertaken by the Minnesota State Board of Health, as stated by H. A. Whittaker, director of the division of sanitation, in an article in the February number of *Minnesota Municipalities*. The investigations have shown that the danger from ice lies more in the way it is handled during its distribution to the consumer, and by the consumer, than in the ice itself, provided certain rules are observed in harvesting the supply. The bacteriological results, besides showing the purification of water which takes place on freezing, indicate the need of thoroughly removing soft, cloudy ice from the surface of the cake before the ice is stored or distributed to the public. All of which leads the Minnesota State Board of Health to make the following rules governing the harvesting of ice: (1) Bodies of water as free as possible from pollution should be selected for the ice field. (2) The water under the ice at the time of harvesting should be at least 3 ft. deep and free from suspended material of every description. (3) Ice fields should not be selected at locations where the surface of the ice may be flooded with polluted material which will subsequently become frozen and form a portion of the cake. (4) The ice should be clear and free from visible foreign material. (5) Before storing, the surface of the ice should be scraped free from snow, soft ice and foreign material. (6) Special care should be taken during the cutting to exclude any ice polluted by human or animal excreta.

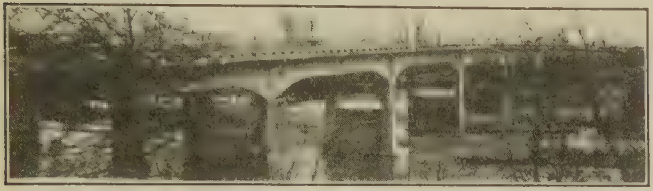
California's Bridges as Good as Her Highways



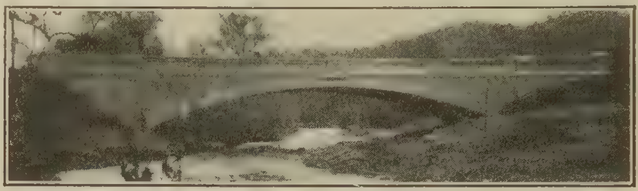
LOS ANGELES COUNTY BUILDS FOR 35-TON TRUCKS OVER SAN GABRIEL RIVER



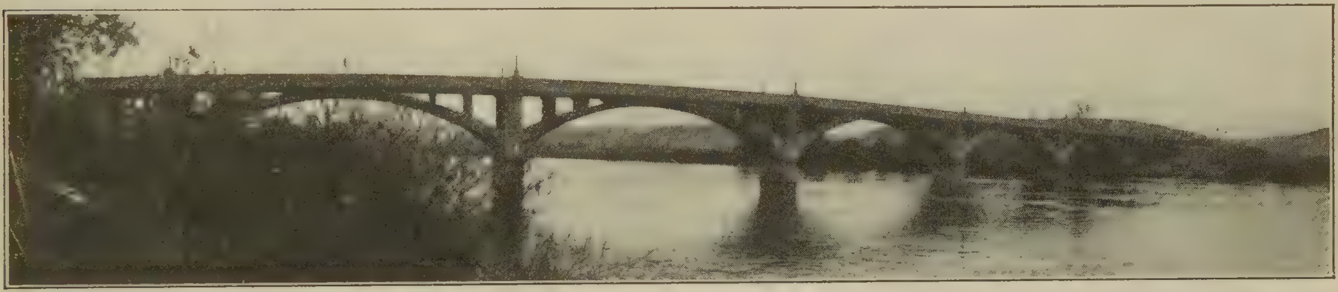
CEMENT STUCCO DECK GIRDERS OVER VERDUGA WASH, NEAR LOS ANGELES



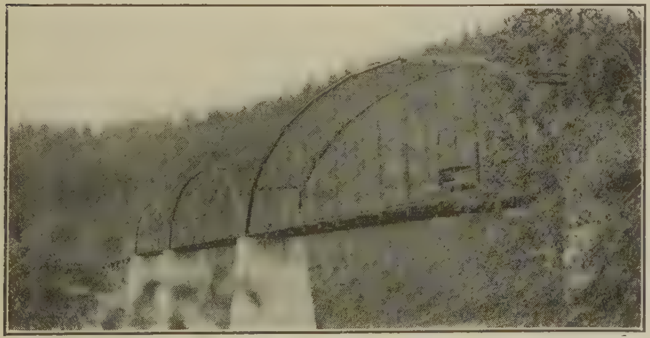
CONTINUOUS-GIRDER DESIGN BY GIVAN AND PEARCE—BEAR RIVER, PLACER COUNTY



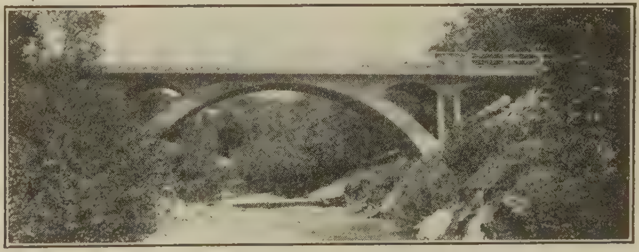
EIGHTY-FOOT REINFORCED CONCRETE ARCH, ATASCADERO CREEK, SAN LUIS OBISPO COUNTY



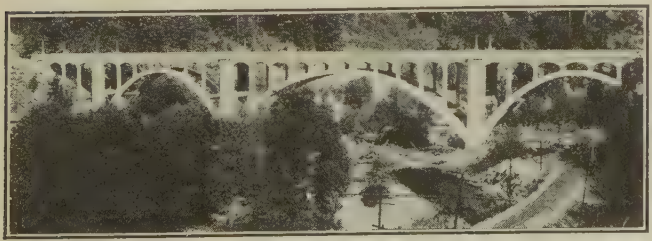
THE CITY OF REDDING IS MADE ACCESSIBLE BY FIVE 115-FOOT SPANS OVER THE SACRAMENTO RIVER—DESIGNED BY A. V. SAPH



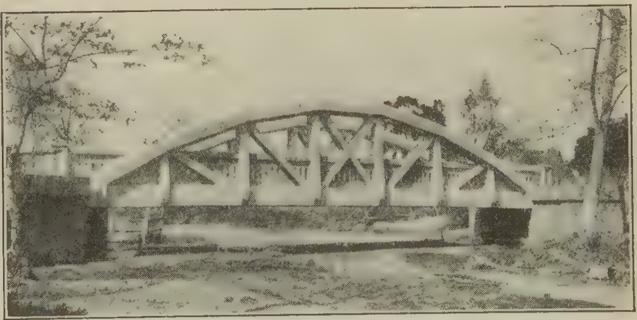
DIFFICULT TOPOGRAPHY RESPONSIBLE FOR LONG, HIGH SPANS OVER EEL RIVER



ARCH WITH "MUSHROOM" FLOOR DESIGNED BY C. A. P. TURNER, ELDORADO COUNTY



AT DUNSMUIR THE SACRAMENTO RIVER LIES 70 FEET BELOW THE BRIDGE FLOOR



PERMANENT ESTHETICS FOR SANTA BARBARA COUNTY—EDWARD T. FLAHERTY, DESIGNER

Test Procedure for Obtaining Weight per Cubic Foot of Sand

Size and Shape of Measure, Method of Filling and Amount of Moisture Varied—Wet Sand Shows Wide Variations—Dry Sand Necessary

EXPERIMENTS for the purpose of ascertaining the method and apparatus by which the most reliable results in the determination of the weight per cubic foot of sand by different operators under different conditions may be obtained were reported by Sanford E. Thompson, chairman of the committee on aggregates, at the last annual meeting of the American Concrete Institute. This work was done under the auspices of a joint committee of the American Society for Testing Materials and the American Concrete Institute, under the direction and supervision of a subcommittee on weight, voids and specific gravity, of which Cloyd M. Chapman is chairman.

The conclusions reached as the result of these tests are here reproduced.

Conclusions Based on Dry Sand

Remembering that the variables which need to be standardized are (1) the size and shape of the measure, (2) the method of filling the measure, and (3) the amount of moisture in the sand, experiments were made at seven different laboratories on sand of two grades—one coarse, the other fine. With wet sand a much greater range in average weight, average maximum variation and mean variation was obtained. Because of this great range, the conclusions presented in the discussion are based wholly on the results for dry sand.

Seven different methods of filling the measures were tried, namely: A, filled and struck; B, filled and jarred; C, jarred while filling; D, tamped in layers; E, filled and tamped; F, filled through funnel; G, inner tube, and a cone method used in one laboratory only. The lower weights were obtained by methods A, F and G, while the higher weights resulted from methods C, D, and the cone. The cone method showed least total variation, with methods D and G as second choice, while for mean variation the cone method was lowest, with methods F and D as second and third.

Size of Measure of Little Importance

The results for size and shape of measure show slightly higher values for larger cylindrical measures than smaller ones, while the cubical measures of ¼ cu. ft. capacity gave a somewhat lower result, probably due to failure of the sand to pack as closely in the corners. The differences are small, however, and may not influence the choice of size, except to show that one size and shape should be adopted as standard. The cone measure, due chiefly to the method of compacting and filling, gives very much higher weights, so high, in fact, as to bear little relation to the weight per cubic foot of sand in any condition which would be found in practice. The mean variation shows that, size for size, the round measures are more concordant than the square measures.

Before a definite choice can be made of both method and container it will be desirable to conduct further investigations to ascertain the degree of compactness of sand in the various conditions in which it exists on the job and in concrete and mortar. Such investigations are in progress, and a choice of method and measure will be recommended for adoption when more complete data are gathered.

Scituate Reservoir Will Be Cleared, But Not Stripped

Annual Report of Providence Water Supply Board Describes Treatment of Storage Basin

IN the annual report of the Water Supply Board of Providence, R. I., dated Jan. 1, 1917, it is announced that the area to be flooded by the proposed Scituate reservoir will be cleared, but not stripped. The new basin will have a capacity of nearly 37,000,000,000 gal. and a water surface of 3400 acres, with an average depth of 33 ft. On the subject of stripping the report contains the following:

"By reservoir stripping is meant the removal of surface loam to a depth usually of about 1 ft. There are very few reservoirs used for water supply or other purposes which have been stripped, nearly all of which are in Massachusetts, the largest being the Wachusett Reservoir with an area of about 4100 acres, and the next largest being the Sudbury Reservoir with an area of about 1300 acres. The other stripped reservoirs are of very small size. The entire supply for the city of New York, outside of the ground waters used on Long Island, is from unstripped reservoirs, the same being true of practically all supplies from reservoirs except those of a few cities and towns in New England. It was decided not to strip the Scituate reservoir but to substitute therefore thorough clearing. Such clearing consists of cutting all trees, grass and other vegetation as closely to the ground as practicable, burning or otherwise removing all débris, thoroughly disinfecting all areas subject to pollution, digging out stumps in the vicinity of the flow line, and the general elimination of all active organic matter immediately previous to flooding the reservoir. With immediate filtration there was believed to be no adequate reason which would justify the great expenditure necessary for general stripping, and the stripping of soil will be limited to the areas necessary to furnish so much of this material as may be required in connection with the construction of the Scituate Dam and other structures."

For the Providence Water Supply Board Frank E. Winsor, formerly a department engineer on the Catskill Aqueduct, New York City, is chief engineer.

Increase Water Storage at Pueblo, Col.

Work has been started on additional storage facilities for the City View reservoir and irrigation system located west of and adjacent to the city of Pueblo, Col. Water for the irrigation of at least 500 additional acres of land will be impounded. The present dam is to be increased to 37 ft. in height and 300 ft. long. In addition, a pressure tower 39 ft. high will be built, as well as a pumping plant for raising water to the ground on higher levels than the reservoir.

Plotting Water-Turbine Characteristics

Charts Show Relations Between Variables in Equations—Permit Quick Estimate of What Runner Will Do Under Various Conditions

By JESSE W. SHUMAN
Treasurer Power Engineering Company, Consulting Engineers, Minneapolis, Minn.

THE CONSTRUCTION of charts for water-turbine characteristics will repay any engineer engaged in hydraulic power work, as by so doing much time spent on tedious arithmetic is saved. The greater the care used in constructing the curves, the more accurate will be the results, and with reasonable accuracy the results will be correct to within less than 1 per cent. The values taken from the charts will be sufficiently close, especially as manufacturers usually discount test results in making guarantees. The writer has not recently seen logarithmic paper used for the construction of straight-line charts of equations which, if plotted in their original forms, would produce curves. Therefore, he feels that the following suggestions will be of interest.

The Equations Commonly Used

The equations widely used for comparing the performance of water turbines of different diameters and under varying heads and speeds are as follows:

$$N = N_1\sqrt{H} \qquad (1)$$

$$Q = Q_1\sqrt{H} \qquad (2)$$

$$N_1 = ND/D_1 \qquad (3)$$

$$P = P_1H^{3/2} \qquad (4)$$

and

$$P = P_1D^2/D_1^2 \qquad (5)$$

Where N = number of revolutions per minute under head H; N_1, number under 1-ft. head; Q, discharge in second-feet under head, H; Q, discharge in second-feet under 1-ft. head; P, horsepower developed under head H; P, horsepower developed under 1-ft. head; D, diameter in inches of turbine to be compared, and D, diameter in inches of a tested turbine.

One way to determine the size of a turbine runner, and its speed and discharge, to develop a certain amount of power under a known head, is to refer to a Holyoke test of a runner of homologous design. By the use of the foregoing equations we can estimate the size of the runner, as well as other of its characteristics, directly from test data. Our problem may be to check up guarantees made by a manufacturer, and several different heads may be under consideration. While these equations are easily solved, it requires a certain amount of work to lock up square roots and three-halves powers of numbers. Inasmuch as an analysis of a turbine sometimes calls for working from two ends, namely, from test to actual operating conditions, or vice versa, considerable figuring is necessary. The use of logarithms expedites matters, but they too are tedious and require time. If care is taken in constructing the charts on logarithmic paper, the results will be correct to within less than one per cent.

The charts show the relations existing between the different variables in the equations 1 to 5 inclusive. They require only an explanation of their construction to enable one to make comparisons quickly, or to ascertain what a runner will do under any condition of head and speed. There are other formulas, but those mentioned are the principal ones. It is possible to construct other charts expressing relations between other variables if desired.

Fig. 1 is the chart for equations 1 and 2, which can be rewritten in their logarithmic forms as follows:

$$\tfrac{1}{2} \log H = \log N - \log N_1$$

and

$$\tfrac{1}{2} \log H = \log Q - \log Q_1$$

First consider equation 1. The divisions on the hori-

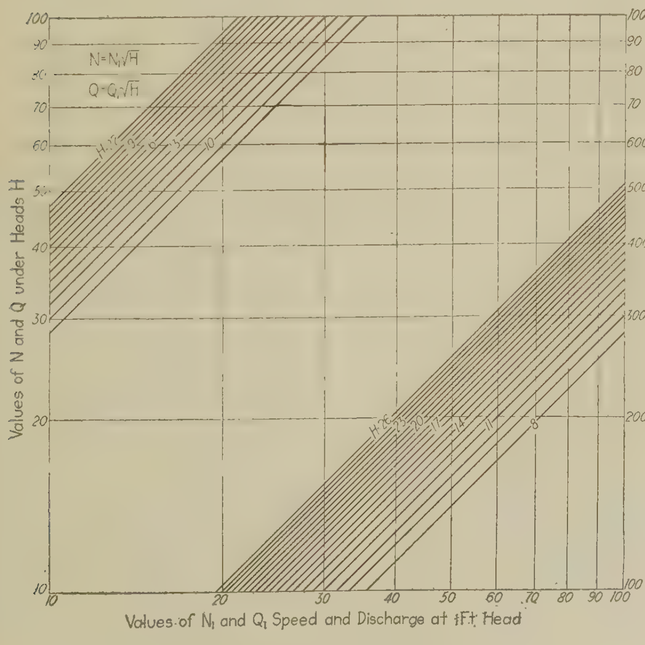


FIG. 1—CHART FOR EQUATIONS 1 AND 2

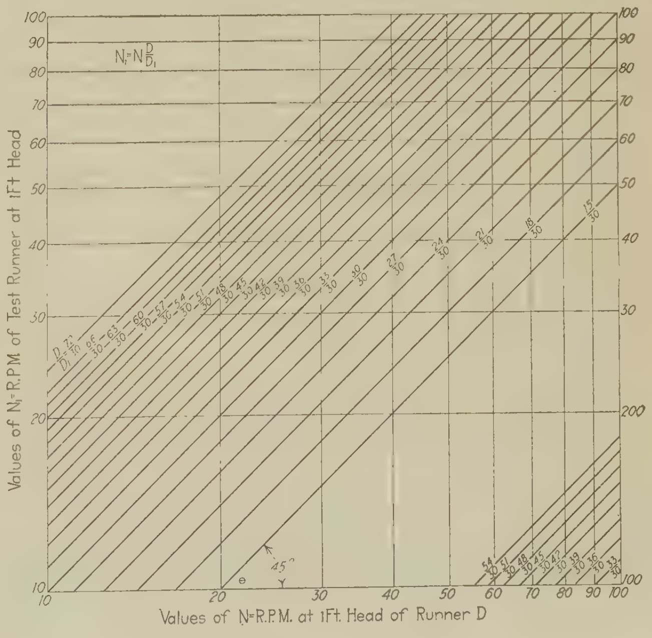


FIG. 2—CHART FOR EQUATION 3

zontal axis are numbered from 10 to 100, corresponding to the unit speed of a turbine runner at 1-ft. head. The divisions on the left-hand vertical axis are also numbered from 10 to 100, and correspond to values of the speed of the runner under the head H. The diagonal lines are each numbered for a different head and are constructed as follows: Take two different values of N and solve the equation $N = N_1\sqrt{H}$ for N under a certain head H. This gives two points on the diagonal line. For example, assume that $N_1 = 20$ and 30 and $H = 9$. Then $N = 20\sqrt{9}$, or 60, and $N = 30\sqrt{9}$, or 90.

These values of N are laid off over verticals erected at points corresponding to values of N_1 (20 and 30 respectively). A line is now drawn connecting the intersections, as $H = 9$. One sees at a glance that for a runner speed of 20 at 1-ft. head, the equivalent speed of the same runner under a head of 9 ft. is 60.

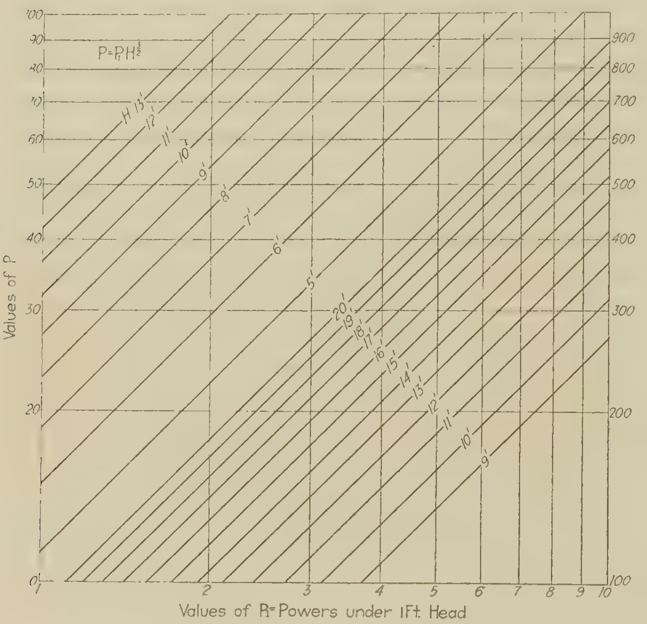


FIG. 3—CHART FOR EQUATION 4

In laying out the lines for other heads, as $H = 10$, 11, 12, etc., it is necessary to solve the equation for only one point, and draw lines through these points parallel to the master line. When a head of 12 ft. is reached a vertical erected over the unit speed of 30 would not intersect the line $H = 12$ within the limits of the chart. Consequently the line $H = 12$ is started again at the bottom of the chart. It will be noted that the lower end of the second diagonal is directly below the top end of the first diagonal, and that the divisions on the right-hand vertical axis are numbered from 100 up. In other words, using these charts is quite similar to using the slide rule. We must know which end to use, according to the values under consideration.

After a master line is drawn—having been located accurately by solving for two points on it as far apart from each other as possible—all other lines, for as many different heads as desired, are drawn by solving for one point only, and drawing a line through each point parallel to the master line. The chart shows lines up to $H = 26$ ft. If we note by Holyoke test, reduced to 1-ft. head, that the runner's speed is 50, its speed at 8-ft. head would be 140. If its unit speed at 1-ft. head is 20, the speed under 8-ft. head would be 56.6. We can read backward by reversing the procedure.

EQUATIONS 2 AND 3

Inasmuch as equation 2 is identical in form with equation 1, and owing to the fact that the unit speeds and discharges in cubic feet per second under 1-ft. head are very nearly the same, similar notations on both axes will serve for equations 1 and 2. The tangent of the angle these lines make with the horizontal is equal to 1, which is the tangent of 45 deg.

Equation 3 can be rewritten in its logarithmic form, which is $\log D/D_1 = \log N_1 - \log N$.

In this equation D_1 and N_1 are the diameter and unit speed of the test runner. In this case the diameter is assumed to be 30 in. The chart for equation 3 shows a series of diagonal lines, marked from $D/D_1 = 30/30$ as the master line, down to $D/D_1 = 15/30$ and up to $D/D_1 = 72/30$. In constructing the chart, we solve for points and use the different ratios of D/D_1. The unit speeds under 1-ft. head for test runner are shown on the vertical axis; the unit speeds for the runner of diameter D at 1-ft. head are shown on the horizontal axis. Both axes are numbered from 10 to 100, the vertical axis at the right-hand lower corner being numbered from 100 up. To construct this chart, start with the diagonal line, which represents a ratio of $D/D_1 = 30/30$. Assuming values of $N = 30$ and 50, N_1 will equal 30 and 50. This gives two points on the diagonal lines, which will make an angle of 45 deg. with the horizontal. By solving this equation, with the same value of $N = 30$, and with different values successively of D/D_1, we obtain one point for each line. Draw lines through each point and parallel to the master line. We see now that if a 48-in. runner is under discussion and is of homologous design with the tested 30-in. runner, its speed under 1-ft. head will be 20 if the test runner's speed is 32, or will be 37.5 if the test runner's speed is 60.

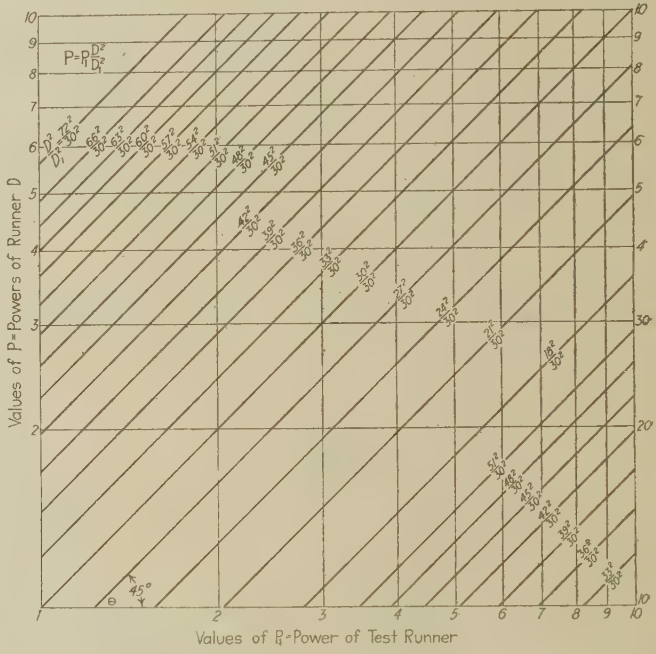


FIG. 4—CHART FOR EQUATION 5

Equation 4, $P = P_1H^{3/2}$, in its logarithmic form reads $3/2 \log H = \log P - \log P_1$. This equation is used to compute the power of a runner at any head if its power at 1-ft. head is known. The chart is constructed as were the others. The horizontal axis represents powers at 1-ft. head and is numbered from 1 to 10. The vertical axis represents powers under the head H and is laid out on the left from 10 to 100 and on the right from 100 to 1000. The chart shows diagonal lines marked $H = 5$ up to $H = 20$. A master line is first drawn, located by solving the equation for two points. The other lines are drawn parallel to the master line through the points located by solving the equation. Looking at the finished chart, we see that if $P_1 = 6$, the same turbine, at the same efficiency, would under 9-ft. head develop about 163 hp. Or, if it develops 2 hp. at 1-ft. head, at 13-ft. head it should develop about 93.7 hp.

The logarithmic form of $P = P_1 D^2/D_1^2$ is $\log D^2/D_1^2 = \log P - \log P_1$. In this equation, P and D are the power and diameter of the runner under discussion, and P_1 and D_1 are the power and diameter of the test runner. The chart, very similar to Fig. 2, shows a series of diagonal lines marked, in this case, as the ratios of D^2/D_1^2. The same number of lines is shown, but the relative positions on the chart differ.

The chart is constructed by the same method as the others, and particularly like that in Fig. 2. The horizontal axis represents values of P_1 and is numbered from 1 to 10 as unit powers. The vertical axis represents values of P and is numbered from 1 to 10 on the left-hand axis, and from 10 to 30 on the right. By keeping in mind relative values, and properly locating the decimal point, this chart can be used for other heads

USES OF CHARTS

To show some of the uses to which these charts can be put, assume that we desire to ascertain the size of a waterwheel to develop about 576 hp. under a 16-ft. head at 120 r.p.m. (a synchronous speed).

Fig. 1 shows that a runner rotating at 120 r.p.m. under a 16-ft. head would run 30 r.p.m. under 1-ft. head.

Fig. 3 shows that if a runner develops 576 hp. at 16-ft. head, it would develop 9 hp. at 1-ft. head.

Referring to Fig. 4, we see that the horizontal line from 9 hp. (on the vertical axis) crosses diagonals from $72^2/30^2$ to $30^2/30^2$. At first thought it would seem that there would be a large variation of runners that would fulfill our conditions. That would depend upon their design and ability to develop, at 1-ft. head, the unit powers shown at the foot of each vertical dropped from the point of intersection of the horizontal line (9 hp.) and the diagonals. To select a possible and commercial size it is necessary to consult the Holyoke tests of available types and to note, by inspecting their performance, an efficient unit power. Suppose we note by a test sheet that unit powers of a 30-in. runner are possible, at good efficiency, between 4 and 5 hp. The diagonal line $45^2/30^2$ intersects the horizontal line from $P = 9$ hp. at a vertical erected over the unit power of 4. This shows that a 45-in. runner of the same design as the test runner would answer our purpose. The 45-in. runner will revolve at 30 r.p.m. under a 1-ft. head. Therefore, by looking again at Fig. 3, we see that this means a speed of 45 r.p.m. for the test runner. If the test data show that at this speed the efficiency is good, the size selected will be approximately correct.

We can also work from the test data end, and finally arrive at the size and resulting speed of the runner. In case the speed so secured is not synchronous, and the turbine is for direct connection to an alternator, it will be necessary to work back and forth until the proper synchronous speed is secured.

Soldiers Construct Mess Halls at Fort Sam Houston, Texas

Details of Material Used and Methods Adopted Are Given—Thirty Men Build One 20 x 64-Foot House Per Day

By CHARLES S. DUKE
Chicago

THAT the scope of activities to be performed by the modern soldier has been greatly enlarged in recent years is attested by the construction of a large number of mess halls by the militia and regular army at Fort Sam Houston, Texas, during last summer. Sanitation, the war waged upon germs, has been found no less important than action against a hostile enemy. In using soldiers on construction work the authorities were well within the power granted by the army regulations. It was the extent to which this was done that has been the cause of some comment.

TYPICAL VIEW OF MESS HOUSES CONSTRUCTED BY SOLDIERS

In the typical case of an infantry regimental unit, there were built, usually, nineteen mess halls, six 20x36 ft. and thirteen 20x64 ft. Of the smaller size, one was

MATERIALS USED IN BUILDING THE LARGER SIZE HOUSES

No. of pieces	Size, in.	Length, ft.	Description
4	2 x 4	20	Sills and plates
16	2 x 4	16	
7	4 x 4	14	Posts
2	2 x 4	18	Braces
1	2 x 4	12	
1	2 x 4	20	
17	2 x 4	14	Studs
9	2 x 4	16	Ribs
2	2 x 4	18	
18	1 x 4	16	Belt and rail
5	1 x 4	18	
9	1 x 12	16	Base
8	1 x 12	18	
8	1 x 8	16	Frieze
5	2 x 4	18	Collar, beam
1	1 x 6	14	
5	1 x 6	20	Ties and ridge
4	1 x 6	16	
6	2 x 4	16	Vents
1	4 x 4	8	
38	2 x 4	18	Rafters

MISCELLANEOUS

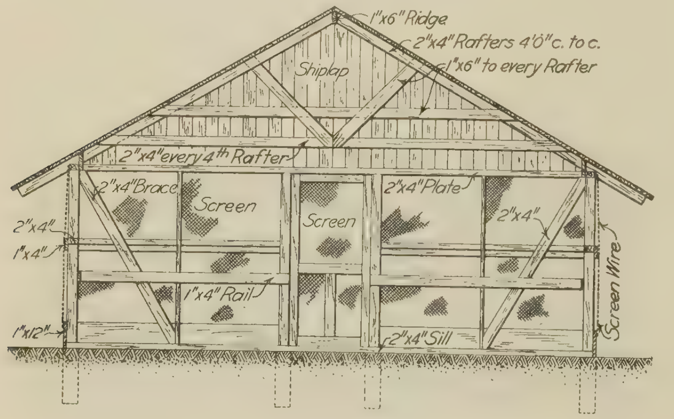
2200 ft. b.m. sheathing, 140 ft. b.m. shiplap gables, 3 screen doors 3 x 6 ft. 8 in., 188 lin. ft. 36-in. screen wire, 188 lin. ft. 34-in. screen wire, 40 lin. ft. 18-in. screen wire, 26 sq. ft. 2-ply roofing paper, 50 lb. 16d. nails, 200 lb. 8d. nails and 15 lb. screen tacks.

used for headquarters, three for battalion, one for supply and one for headquarters company. Of the large size, one was used for the machine-gun company and the remaining twelve for companies of the line. The center line of each of the larger halls, which were located at the head of each company street and flanked on the left by the headquarters-company mess hall and on the right by the supply-company mess hall, coincided with the center line of the row of company tents.

DETAILED LIST OF MATERIAL USED

The materials used were pine lumber, tar-paper roofing and wire screening. The bill of materials for each of the larger size houses is given in the table on page 387.

A commissioned officer was detailed in charge of the work and was held accountable both for labor and materials. The execution of various parts of the work was under the immediate charge of non-commissioned officers, the work usually being divided into carpentry, roofing, teaming, and general labor. The carpentry was done by the company mechanics, there being one detailed from each company to the construction gang. Special details of other soldiers from such companies as seemed to afford the best material completed the construction organization, which amounted usually to between 30 and 50 men. A civilian carpenter was employed to work with the carpenter squad.



CROSS-SECTION OF BUILDING SHOWS MATERIAL USED

ONE HOUSE COMPLETED EACH DAY

After one or two houses were constructed, the men were sufficiently trained and proceeded rapidly with the work. A squad of 30 men working nine hours a day usually completes one house per day. The progress of the work was greatly facilitated by an undercurrent of rivalry existing among various regiments.

At one end of the building and near the kitchen door was built a brick incinerator, upon which were mounted a Sibley stove and a galvanized pan 6 in. by 2 x 4 ft. for evaporating liquids. Over the ash-pit grate bars were installed for drying out solid garbage. About 500 bricks were used in the construction of each incinerator.

Where Four Miles a Day Is Speed

During the five-year period ended in 1914 Georgia surfaced 6364 miles of her roads. This is at the rate of more than 4 miles per working day.

Low-Grade Dynamite and the Labor Shortage

Even Blasting of Soft Materials to Insure Capacity Operation of Excavating Tools Now Found Profitable

PROBABLY one of the chief labor-saving developments in the construction field resulting from the increasing cost and scarcity of common labor is the recent development and use of the lower grades of dynamite, according to E. I. du Pont de Nemours & Company. In rock, the efficiency of and the necessity for using dynamite have long been recognized, but when this high-grade explosive was applied to earth excavation the results were far from satisfactory. This, of course, is due to the fact that rock work requires a quick-acting, shattering force, while in earth a comparatively slow-acting explosive with a heaving or lifting effect is desired. Recognizing the usefulness of such an explosive at the present time, manufacturers have developed a low-grade dynamite for this purpose. This explosive, having a slow, heaving action, is comparatively insensitive and safe to handle. It is also low-freezing. Contractors are now using it in conjunction with all types of mechanical excavators to hasten and cheapen the work.

LOOSENS COMPACT EARTH FOR STEAM SHOVEL

The method generally pursued is to do the drilling or punching of the bore holes and the firing at a time when it will not interfere with other operations. Even where the steam shovel is used, it frequently pays to loosen the material ahead where large boulders, compact earth or hardpan is encountered. To secure the maximum efficiency of the machine, the shovel must be filled at every trip. On this account it is no longer profitable in hard digging to make the shovel do very much ripping and loosening of the material, or to operate it far below full capacity. Often the use of a little explosive on large boulders, stumps or other obstructions saves a broken cable and consequent delays.

ALSO AN AID TO LIGHTER TOOLS

On dredge-bucket excavation where it is difficult to secure full loads, good results can frequently be obtained by loosening the bottom with light blasts. In shallow excavation, where scrapers, elevating graders and similar tools are used, plowing is usually resorted to to loosen the soil sufficiently for these machines to handle it. In compact ground, where stumps and roots are encountered, or where there is little room in advance of the cut to drive and turn horses or operate tractors, such plowing represents a labor expense which has increased to considerable proportions. By the proper use of low-grade explosives this expense may be largely eliminated. Hand picking and shoveling in corners may also be dispensed with at considerable saving by the use of such explosives. Where the work is so restricted that only hand labor is practicable, still greater economies are possible.

Excavation carried out while the ground is frozen is always expensive. In some cases, however, work must be carried on during cold weather, and under these conditions dynamite is one of the most efficient laborsavers.

Compares Flat-Slab Design Requirements in Light of Test Results

A. R. Lord Believes Recommendations of Joint Committee to Be Ultra-Conservative—Advocates Modified Concrete Institute Values

FLAT-SLAB design recommendations of the Joint Committee on Concrete and Reinforced Concrete, accepted at the last annual meeting of the American Society of Civil Engineers (see the Engineering Record of Jan. 13, page 55), are compared with the recommendations of the Committee on Reinforced Concrete and Building Laws of the American Concrete Institute (accepted at the last annual meeting, but not to be sent to letter ballot until next year) by A. R. Lord in a paper presented before the Southwestern Cement Association on Feb. 22.

Reviewing the results of tests of four buildings in Chicago, Mr. Lord concludes that the Joint Committee values are ultra-conservative and recommends modified values, with a different steel distribution for the two-way and four-way systems. Tables and diagrams, some of which are here reproduced, show the varying percentages for the moment requirements, the average results of tests compared with values computed according to the Chicago ruling, and the distribution between diagonal and direct bands as indicated by these tests.

COMPARISONS WITH CHICAGO RULING

Among city building regulations the flat-slab code of the Chicago Building Department was the first to be adopted. It is still the most conservative and has found wide acceptance among building departments from coast to coast. It was based on the work of five expert commissions appointed to establish design standards for use in Chicago. The reports of the Joint Committee and the Concrete Institute Committee (Mr. Lord was a member of the latter) are compared with the established values of the Chicago ruling and the data of tests of buildings designed in accordance with Chicago practice, as Mr. Lord believes that flat-slab design must necessarily be largely based on test and service records of actual buildings.

The accompanying Table 1 (rearranged and slightly modified to give consistent values) is taken from a discussion by T. L. Condron before the American Concrete Institute. It shows the equivalent coefficient for total sum of positive and negative moments and the percentage of distribution allowable to the different sections, defined as shown on the diagram herewith.

As indicated in Table 1, the Concrete Institute report and the Chicago ruling have the same total moment coefficient. This coefficient is the highest in any building code in the United States and the highest heretofore used in practical designing. It represents the most conservative past practice. The Joint Committee report increases this moment 18.5 per cent.

TABLE GIVES SUMMARY OF CHICAGO TESTS

Table 2 gives a summary of four Chicago tests, all of four-way flat slabs of the drop type. All these floors were loaded up to or in excess of twice the total dead and live design load. These tests seem to indicate eminently safe and conservative design. The average steel stress measured at the support was about 9000 lb. per square inch, against a computed stress of about 27,000 lb., using the Chicago ruling. The measured concrete stress was about 700 lb. per square inch, against a computed value of about 1250. At the panel center the average steel stress measured about 13,000 lb. per square inch, against a computed value of 37,000 lb. The concrete stress at the center is always very low—less than half that at the supports. The average stress in the top rods was less than 8000 lb. per square inch, against a computed value of over 70,000 lb. Taking into account the possible and reasonable effect of various loadings and of long continued loading, it would appear that a factor of safety of four was largely exceeded.

COMPUTED MOMENTS FROM MEASURED STEEL STRESSES

Computations of the various resisting moments from the measured steel stresses, even on an extremely conservative basis, show an average total sum for positive and negative moments of $0.025WL$, which is equivalent to a coefficient a of 0.035 in the equation $M = awl_1(l_2 - qc)^2$, as against the value of 0.090 given by the Concrete Institute committee. One of the tests reported, that of the Schwinn Building, involved measurements under load for a full year (see Engineering Record of March 3, page 341), and the increase in the total moment was about 7 per cent, with no increase during the last three or four months. In one test at Seattle (see the Engineering Record of May 13, 1916, page 746) in which

TABLE 1—COMPARISON OF DESIGN REQUIREMENTS FOR FLAT SLAB FLOOR CONSTRUCTION

			Negative Moment in Per Cent			Positive Moment in Per Cent				
Authority	Type	Coeff.*	Column Head	Mid-section	Total	Outer Section	Inner Section	Total	Total Sum	
Joint Committee	Drop	0.107	50	12.5	62.5	28.1 to 22.5	9.4 to 15.0	37.5	100	
	No drop	0.107	50 to 40.6	12.5 to 21.9	62.5	28.1 to 20.6	9.4 to 16.9	37.5	100	
Concrete Institute	Drop	0.090	60 to 50	10 to 20	70 to 60	18 to 28	12 to 22	30 to 40	100	(not more)
	No drop	0.090	60 to 40	10 to 30	70 to 50	18 to 38	12 to 32	30 to 50	100	(not more)
Chicago Ruling	Four-way	0.087	53.4	13.3	66.7	20	13.3	33.3	100	Based on head = 0.225L
	Two-way	0.093	50	12.5	62.5	25	12.5	37.5	100	
Akme Standard Two-way	Drop	0.096	47	13	60	27	13	40	100	
	No drop	0.099	45	12.5	57.5	30	12.5	42.5	100	

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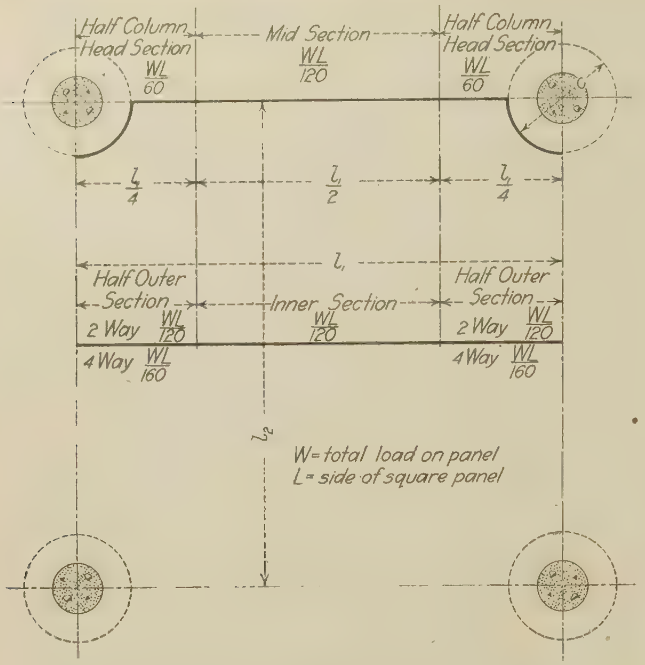
* Coefficient equivalent to a in the expression for total moment $M = awL\ (L - \frac{2}{3}c)^2$, where w is dead and live load per square foot. L is side of square panel, and c is diameter of round column head.



CHICAGO RULING FOR MOMENTS AT GIVEN SECTIONS

exceedingly high stresses were developed, reaching 50,000 lb. per square inch in the steel, the equivalent coefficient for total resisting moment was only 0.066, as against 0.090 specified by the Concrete Institute committee.

Distribution of the Total Moment

The question as to the amount of total moment to be specified in design, says Mr. Lord, is one of conservative versus ultra-conservative opinion. The distribution of the total moment, however, does not admit of so many opinions. The Joint Committee report makes a rigid division of the moment into 62.5 per cent negative and 37.5 per cent positive for any or all types of flat slab. The Concrete Institute committee report leaves a portion of the moment to be assigned in accordance with the physical details of the slab and its reinforcement. If the Joint Committee division is right for a flat slab with a drop and supported by stiff columns, it is wrong for a flat slab without a drop and supported by relatively slender columns.

The evidence of the tests is positive and conclusive on this. For four panels loaded uniformly, the tests show a distribution of approximately ⅝ negative and ⅜ positive moment, with individual cases in which as high as 70 per cent of the total moment has been negative, for buildings with a much deeper drop than the Joint Committee permits. With other conditions of loading, certainly the center or positive moment would be greater and the ratio of negative moment to total moment reduced. With no drop present, the change would be even greater, as shown in the test of the Bell Street warehouse at Seattle, already referred to, where only 40 per cent of the total moment was negative and 60 per cent positive—practically a reversal of the conditions where a large drop is used.

These data give ample basis for the Concrete Institute committee recommendation that permits an extreme division of 50 per cent negative and 50 per cent positive where the drop is not used, and also permits from 60 to 70 per cent negative where the drop is used.

Distribution Different in Two-Way and Four-Way Systems

The Joint Committee assigns a fixed proportion of 12.5 per cent of the total moment to the mid-section in flat slabs with a drop. This does not allow for the fact that the distribution of the moment is different in two-way and four-way flat slabs—a fact clearly brought out in tests. In four-way flat slabs of the Schwinn Building, as shown in Table 2, the calculated stress across the mid-section was over 70,000 lb. per square inch and the actual stress under 10,000 lb. per square inch, even after a year. In the test of the Sears Roebuck Building at Seattle, a two-way flat slab gives a computed stress at this section of 27,200 lb. per square inch and an actual stress of 23,500 lb. per square inch.

This would indicate that the moment across the mid-section is several times as great with the two-way arrangement of the steel as it is with the four-way arrangement. The Joint Committee assignment of moment to this section is too large for four-way slabs and too small for two-way slabs, and the result is an unbalanced design. The Concrete Institute report permits a distribution that will fit either type.

Customary practice in four-way design makes a distribution of the steel between direct and diagonal bands varying from a 1 to 1 ratio to a 1.5 to 1 ratio, and the results of tests as shown in Table 3 indicate that these ratios are about right. The average distribution of the moment was about even between direct and diagonal bands, and this would result in a 1.4 to 1 ratio between direct and diagonal bands. The Joint Committee report specifies as a minimum that 60 per cent of the positive moment must be taken by the outer section, and this gives a minimum relation of 2.1 times

TABLE 2—COMPARISON OF TEST RESULTS AND COMPUTED VALUES

	STRESSES OVER COLUMN HEAD[1]				STEEL STRESSES			
	In steel		In concrete		At panel center[2]		Top rods	
Test	Test[3]	Chicago[4]	Test[5]	Chicago[4]	Test[3]	Chicago[4]	Test[3]	Chicago[4]
Franks	9,200	23,700	1,110	1,400	10,100	31,000	..	..
Larkin	8,500	23,000	800	1,120	16,000	37,000	..	..
Schulze	7,100	22,500	530	1,230	6,200	34,000	4,900	71,500
Schwinn[6]	9,300	38,000	300	1,160	18,900	39,000	9,900	70,000

[1] Average of readings in fully loaded area.

[2] Average of readings on direct and diagonal bands.

[3] Observed steel stresses as reported in tests.

[4] Stresses calculated by Chicago ruling for a design load equal to applied test load.

[5] Concrete stresses reduced to 80 per cent of those reported for the tests and computed on the basis of the initial modulus of elasticity.

[6] Stresses given are for readings taken with full test load in place over one year.

TABLE 3—DISTRIBUTION OF TENSION BETWEEN DIRECT AND DIAGONAL BANDS

	STEEL AREA IN SQ. IN.			OBSERVED STEEL STRESS			TOTAL TENSION CARRIED		PER CENT OF WHOLE	
Test	Two* diagonal bands	Long direct band	Short direct band	Diagonal band	Long direct band	Short direct band	Diagonal bands	Direct bands	Diagonal bands	Direct bands
Franks	10.00	3.54	3.14	6,950	7,350	10,100	69,000	57,000	54.8	45.2
Larkin	11.13	5.10	2.55	12,900	10,200	24,200	143,800	113,800	55.9	44.1
Schulze	8.48	3.45	2.55	4,220	8,400	7,200	36,000	47,400	43.2	56.8
Schwinn	13.89	5.10	4.12	21,900	16,000	18,600	304,000	159,000	65.6	34.4
						Average			54.9	45.1

*Effective section.

as much cross-sectional steel area in the direct as in the diagonal bands.

Moments in Columns

The amount of moment developed in the columns will depend on the type of flat slab and on the stiffness of the columns above and below the slab. For small columns in upper stories of buildings the Concrete Institute specification of coefficient $a = 0.022$ should be ample even where the drop type of flat slab is used. This is a matter where the judgment and calculations of the engineer must decide, but the specification of a definite minimum moment by the Concrete Institute committee seems a step in the right direction. The Joint Committee report and the Chicago ruling leave this in a very indefinite shape, with the result that many designers will entirely overlook the design of the columns for bending moment.

Recommended Design and Construction Safeguards

For engineers designing structures to be erected by the most improved means under positive controls insuring a superior grade of concrete, Mr. Lord recommends the use of the Concrete Institute report, with a moment coefficient of 0.080 instead of 0.090 given by them. For four-way flat slabs with drops, which is the economical type to use, he advises the following distribution of the total moment: Column-head section, 50 per cent; mid-section, 10 per cent; outer section (direct bands), 20 per cent; inner section (diagonal bands), 20 per cent. Where no drop is used, take from 6 to 10 per cent (depending on the column stiffness) of the total moment from the column-head section and distribute it equally over the inner and outer sections. For two-way flat slabs with drops, the following distribution of the total moment may be taken: Column-head section, 50 per cent; mid-section, 15 per cent; outer section, 23 per cent; inner section, 12 per cent.

The engineer's drawings in every case should show a positive mechanical means for securing the reinforcement in the position contemplated in the design. The builder may be permitted to substitute any equally effective means of his own choice, of course, but some adequate device should be shown on the plans so that the builder and the inspector may know absolutely where the steel belongs. Many current plans do not properly take care of this requirement of good construction. The proper fireproofing cover for the rods is very commonly left to the contractor, with bad results. This matter of proper fireproofing of the reinforcing rods is more important than a variation of 10 per cent in the design moments, and engineers cannot take too much care to guard their structures in this respect.

Mr. Lord concludes by stating that he favors the use of high-carbon steel in all flat slabs, for the reasons that it is less easily bent accidentally at places not intended and that it affords a greater ultimate factor of safety as shown by tests, and costs no more than structural-grade steel.

Misleading Maintenance Figures

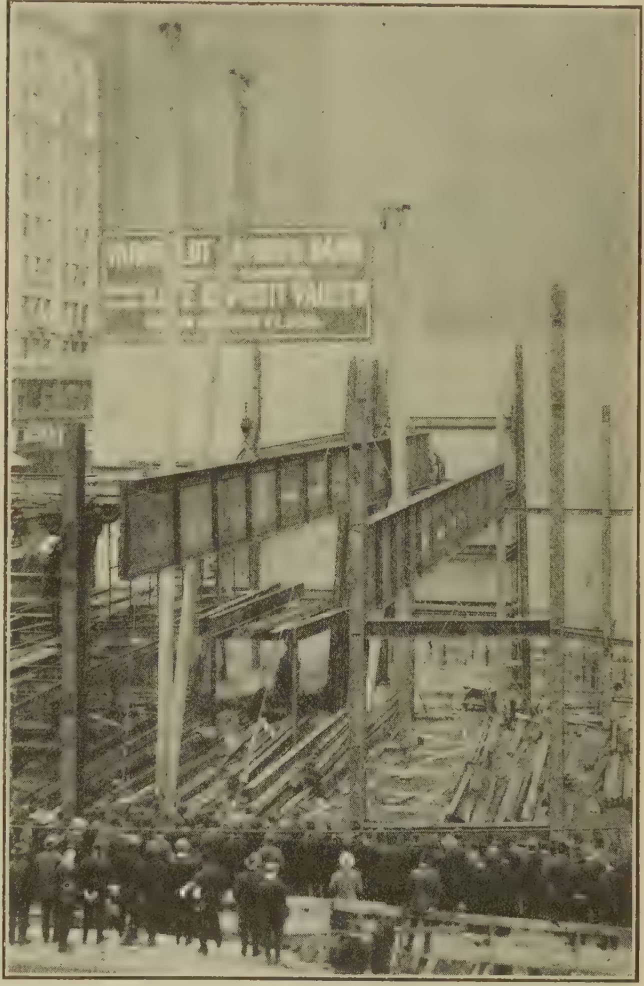
A source of misunderstanding regarding the expenses of road maintenance lies in the fact that the traffic on some roads has increased to an amount for which the pavement is unsuited.

Place Two 88-Foot 35-Ton Girders in San Francisco Theater

Two 90-Foot Guy Derricks Raise Them 36½ Feet in 12 Minutes—Largest Girders Ever Used in Building on Pacific Coast

By J. J. ROSENTHAL
Safety Engineer, Industrial Accident Commission

Two plate girders, 8½ x 88 ft., fabricated in one piece by Jones & Laughlin, of Pittsburgh, and weighing 35 tons each, were recently placed in a San Francisco theater. These girders, which are the largest ever used on a building on the Pacific Coast, were erected by the Dean Construction Company and were placed in the California Theater, Fourth and Market Streets.


PLACING 35-TON GIRDER FOR THEATER BALCONY

The girders supporting the balcony were lifted to a height of 36½ ft. in 12 minutes by two guy derricks specially designed for the task. The derrick timbers were 24 x 24-in. Oregon fir; the masts were 90 ft. long and the booms 85 ft. Each mast was anchored by ten 1⅛-in. cables running to concrete piers.

The girders were clamped and lifted by two cast-steel dogs, each weighing 250 lb., handled by blocks with seven 1-in. steel cables composed of eight strands of nineteen wires each. The hoisting rig held the girders in position until seventy-eight rivet holes at each end were bolted to the 14 x 14-in. columns with drift pins. These pins were soon replaced one by one by ⅞-in. hot rivets.

The writer, in the capacity of construction engineer for the Safety Department of the Industrial Accident Commission of California, supervised the erection and attempted to see that every possible safety precaution was taken.

Commission Urges Use of Water Power for Nitrate Manufacture

California Water Conference Compares Highly Developed Field Abroad with Failure to Utilize Power in This Country

THE attention now being directed toward the use of hydroelectric power in the manufacture of nitrates has led the State Water Problems Conference, appointed by the governor of California, to devote considerable space to this subject in its recent report, an extract of which appeared in the Engineering Record of Jan. 27, page 140. In order to emphasize the latent possibilities in this field in the United States, comparisons are drawn with the nitrate industry in foreign countries. The following has been taken from the report.

SMALL CROP YIELDS FROM U. S. LANDS

Europe uses per acre of cultivated land 200 lb. of fertilizer; the United States uses 28 lb. Germany, in twenty years, by the use of fertilizer has increased the average yield of all crops grown three and one-half times as much per acre as America. The German Agricultural Department reports show that by feeding the soil with 2,000,000 tons of nitrate there was secured an increase in crops of 63,000,000 tons. In Germany intelligent effort has been directed to replace the nitrogenous compounds extracted from the soil by crop growth; in the United States the average agriculturist has seen his land yield steadily decreasing crops without attempting adequate remedy.

The average yield per acre in bushels for various crops in the United States and in Europe is as follows:

	Wheat	Oats	Barley	Rye	Potatoes
Europe	32	47	38	30	158
United States	15	29	25	16	96

"As a measure of preparedness in event of war," the report states, "the United States has been attempting to accumulate a reserve stock of 32,500 tons of Chilean nitrate. Her army and navy use annually in peace 3000 tons. The reserve stock contemplated would make enough explosives to last possibly a week in a modern war, and at the end of that time the nation would be powerless unless her navy were strong enough to enable her to commandeer a supply from Chile, against the efforts of her enemy and possibly the wishes of the world. A cheerful outlook for a nation whose foreign relations are becoming complicated!"

NITRATES FROM THE AIR

A country with great natural water-power resources can by the proper use thereof make itself independent of the foreign supply of nitrates. Nitrates can be readily extracted from the air by hydroelectric power, and where there is a general distribution of the necessary rock deposits used in these processes, which is the case throughout the West, it may be considered that a horsepower and a half of hydroelectric energy will produce a ton of sodium nitrate per year. The method of manufacturing fertilizer from Chilean deposits produces a composition of 12 per cent active fertilizer and 88 per cent useless material on which freight must be paid, while the electro fertilizer product contains 60 per cent of fertilizing material.

The United States is importing from Chile annually 625,000 tons of nitrate, valued before the war at $23,000,000 (including the Chilean export duty of nearly $8,000,000), but now worth $37,500,000. That entire amount of nitrate could be manufactured in California by utilizing 1,000,000 hp. of its unused water power resources. California itself is using about 50,000 tons of Chilean nitrate annually at a cost before the war of nearly $2,000,000, increased now to $3,000,000. Many times this amount should now be used annually in that state, and this will doubtless come in time. A 75,000-hp. hydroelectric plant would supply the nitrates now used in California.

Syllabus of Co-operative System at University of Cincinnati

Object, Method, Matter and Mechanism Set Forth by C. W. Park in Bulletin Issued by U. S. Bureau of Education

A UNIFORM outline of the object, method, matter and mechanism of each course in the co-operative system of education, which has now been in operation at the University of Cincinnati for more than 10 years, has been adopted and is tabulated by C. W. Park, associate professor of English at that institution, in a bulletin on "The Co-operative System of Education," issued by the U. S. Bureau of Education. The objects were first stated by Dean Schneider in 1902 practically as given in the first column of this table, which is here reproduced.

The methods originally suggested for accomplishing objects 7 and 8 have not been found feasible without certain features not readily obtainable at Cincinnati. However, a new method, new matter and new mechanism have been devised for object 8 to meet the situation at Cincinnati, and these are now in the experimental stage. Methods differ more widely than objects for the different courses, and manifestly the subject matter is, or should be, entirely different for the different courses. In fact, such an extensive survey of the curriculum has its main advantage in avoidance of duplication of subject matter.

GENERAL PRINCIPLES OF CO-OPERATIVE SYSTEM

Comparing the earlier with the later courses after reorganization, omitting certain details and changing of emphasis on others constitute the principal features of the modifications made. Purely descriptive courses were discontinued, and descriptive matter in all courses was reduced to a minimum, much of it being assigned as incidental reading to be done when the student was in the shop. By reducing the time given to informa-

Syllabus of the Co-operative System in the College of Engineering, University of Cincinnati

OBJECT	METHOD	MATTER	MECHANISM
TO PROVIDE ENGINEERING TRAINING FROM WHICH THE STUDENT SHALL ACQUIRE:			
1. A foundation in the basic principles of science.	1. Instruction in science and mathematics.	1. Chemistry, physics, mathematics, economics, biology, practical engineering projects.	1. Class and laboratory work; co-ordination with practical experience.
2. Ability to use these principles in practice.	2. Gradual and natural advancement in practical work which uses these principles.	2. An organized sequence in practical work.	2. Co-operation with commercial concerns doing engineering work.
	Concurrent training in the theory and practice of engineering.	An organized sequence in science.	Alternate periods spent by two groups of students at school and at practical work.
3. An understanding of engineering in general, as well as of one special department.	3. Varied exemplifications of theory in the classroom.	3. Experiences of students in different types of work correlated with theory.	3. Co-ordinators and students furnish illustrations.
	Organized visits to a variety of engineering industries.	Visits to waterworks, foundries, soap works, etc.	Organized shop visits.
	Contact with fellow students in different kinds of engineering work.		
4. A working knowledge of business forms and processes.	4. Instruction in economics, management, etc. Reports on shop visits; analysis of shop processes.	4. Fundamental principles of economics (systems, forms, contracts, patents in engineering work, etc.	4. Co-ordination of classroom work with students' experience.
	Practical experience in business forms and procedure.	Reports on organization and operation of waterworks, foundries, soap works, etc.	Practical training organized by co-ordinators to insure experience in business forms and processes.
		Routing of work in shops, time-keeping, rate-setting, cost-keeping, etc.	
5. A knowledge of men as well as of matter.	5. Personal work with men from laborers up to superintendents or managers.	5. Practical work, from laboring to directing.	5. Prearranged course of practical training.
	Instruction in the basic elements of work.	Fatigue, wage systems, employment methods, sanitation, etc.	
6. Drill and experience in the following essentials:			
(a) Doing one's best naturally and as a matter of course.	(a) By regulating promotion and pay on practical work.	(a) Practical performance; classroom performance.	(a) Constant supervision and criticism of student's practical work. Consultations by college officials on advancing students on jobs.
	By maintaining a satisfactory standard in college work.		Internal co-ordination of college departments; conferences on work of students.
(b) Prompt and intelligent obedience to instructions.	(b) By working under the rules of an industrial organization.	(b) Practical work under foremen.	(b) Student is kept at manual labor until he learns to obey orders.
		Using practical experience in science courses.	Co-ordination of theory and practice.
	By learning the reasons why things are done.	Work syllabi.	Study of work syllabi.
(c) Ability to command intelligently and with toleration.	(c) By gradual rise to positions of responsibility in the co-operating companies.	(c) Practical jobs of more and more authority and responsibility. Personal experience in hard work.	(c) Success of student on practical and theoretical work checked by co-ordinators. Round table discussion in shop management courses.
	By courses dealing with conditions under which men work.	Fatigue, wage systems, employment methods, sanitation, etc.	
(d) Accuracy and system.	(d) By practical work which requires mental and manual accuracy, and which proceeds with a sequential orderliness. By insistence in school on accurate work and orderly methods of presentation.	(d) Carefully selected jobs. Analyses of shop processes in class. All college courses.	(d) Close familiarity with outside work through visits of co-ordinators. Co-ordination between departments to maintain standards.
(e) Ability to write clearly and concisely, and to present technical matter interestingly before an audience.	(e) By constantly requiring written work under criticism, and by requiring oral presentation of technical matter.	(e) Reports on shop work. Reports on shop visits. Laboratory reports. Student engineering society papers and discussions. Class practice under criticism.	(e) Co-ordination of English department with other departments in criticizing all written work. Student engineering societies afford practice in oral presentation. Regular class exercises in presenting engineering reports.
7. Ability to meet social requirements easily.			
8. An appreciation of humanity's best achievements.			

tional studies, more attention could be given to the fundamental subjects that could be given in the regular four-year course. These features are based on the underlying principles of the co-operative course—the reality of first-hand knowledge as against a merely bookish approach, and that the school is primarily a teaching institution designed to give training that cannot easily be obtained through any other agency.

The first three years of civil, mechanical, electrical and other engineering courses were made essentially the same in theory. Thus if a student discovered during the first three years of practical experience that he was better suited to a different kind of work he could easily change his course.

MOST IMPORTANT ELEMENTS

From the employer's point of view the most important elements of the co-operative plan are: First, the selection of the workers; and, second, the awakening of an enlightened interest in their work through co-ordinated instruction. From the standpoint of the school and the student, the most important feature is the realization of theory through practical applications.

Irrigation Settlers Require Aid in Wyoming

State Engineer Proposes Sales of Public Lands to Furnish Funds for Farmers and for Building State Highways

TO PLACE the landless man on the manless land successfully, material aid is required to tide him over the pioneer period of settlement. This and the statements that follow appear in the biennial report of the Wyoming state engineer, James B. True. The time swiftly approaches, Mr. True says, when it will be absolutely necessary for some centralized public authority to give the settler assistance in establishing himself upon the land.

To-day in Wyoming, says the report, there are hundreds of thousands of acres of unoccupied land which are commanded by completed irrigation systems. The unaided settler of small means cannot hope to succeed on these lands under the present system and policies. Even individuals, endeavoring to irrigate their land by means of small private ditches, are encountering serious financial difficulties. The cost of equipping a farm alone has increased 137 per cent in the past ten years, to say nothing of the time and money required for improvements.

REQUESTS FOR EXTENSIONS OF TIME FREQUENT

Hundreds of requests for extensions of time which are received by the state engineer state that the applicant, being a poor man, is forced to work away from home most of the time in order to obtain a living for himself and family, and that his earnest efforts to reclaim his land are therefore confined to short, uncertain and unseasonable periods. Great numbers of most desirable citizens are forced by meager circumstances to spend a considerable part of their energies and lives struggling to bring their land into productive cultivation when, with proper financial aid and competent direction, this trying period would be greatly shortened and cheapened. The proposed state aid would enable him to devote his entire time to his farm, bring it quickly under cultivation and thus obtain from the land itself an independent living income.

There is no enacted legislation, federal or state, which will aid the new settler in the arduous, costly task of transforming raw sage-brush land into an irrigated farm. The Federal Rural Credits Act requires a first lien on improved land as security. The new settler has no such security to offer; on the contrary, he is burdened with additional liabilities during each stage of his efforts to acquire a living income and a home. The proposed federal act, which will guarantee the interest on irrigation-district bonds, in no sense applies to the problem here presented. Such a district would necessarily be formed in a fairly prosperous, well-settled community whose assets would furnish ample security for the irrigation bonds.

STATE AID FEASIBLE

The plan of state aid in irrigated-land settlement is not a theoretical or impossible one; it is feasible, practical and inevitable. In every country where this system has been adopted it has been proved a practical success, and in no instance has it failed to pay its own way. The plan is based on sound business principles. It does not require the state to donate any money but merely to set aside a permanent revolving fund to be invested, under capable and careful control, in the first essential improvements of raw land and in loans to actual settlers for such improvements, necessary materials and equipment. The money thus invested would have as security a first lien on the land and improvements would be repaid, with a low interest rate, on the long-time amortized plan.

Newcomers are not familiar with good irrigation practice and scientific farming. Oversight and direction along these lines would help them secure the highest possible returns from their land and prevent costly mistakes. By this method the state would have direct control of land settlement, and could exercise some choice in the selection of its settlers by determining the requirements and qualities of character, ability and experience necessary to make them safe risks. The state could prevent land speculation, which is always accompanied by inflated values. High interest and commission rates on loans would be eliminated, and the state would have landowners instead of tenants.

SALE OF PUBLIC LANDS THE SOLUTION

The sale of 4,000,000 acres of public lands in Wyoming, one-half of the proceeds to be used for the construction and maintenance of state highways and one-half to go to a permanent rotating fund for state aid in land settlement, is the solution of the financial problem, Mr. True believes. The state is now planning to undertake the construction of a comprehensive system of highways. These highways will necessarily be built over large areas of public lands, which will greatly enhance their value; yet there is no way to assess a proportionate share of the cost of such construction on these lands. The increased value of the remaining public domain, caused directly by these agencies, he believes, would more than offset the actual value of the lands sold.

Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Water the Chief Factor in Making Concrete

SIR: In regard to the proportion of water to use in concrete, the discussion of which is now before your readers, the writer thinks one vital point has been overlooked. He believes that the change from dry to wet concrete was largely due to the increase in radical design, thin sections and large proportionate increase of steel.

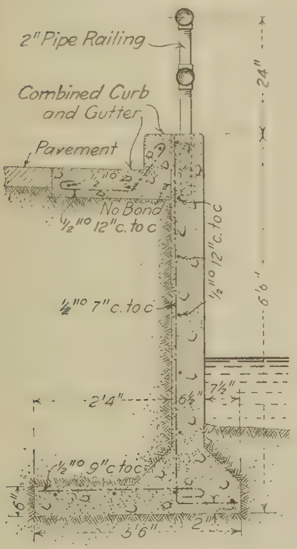
The construction engineer is given a set of plans and his job is to build them. If, as is not infrequent, the sections are thin and steel is thick, how can the concrete be placed unless it is wet?

The writer has under construction a structure with walls 18 ft. high, 12 in. thick and reinforced both sides with ⅝-in. steel on 6-in. centers both ways. The writer cannot conceive how to place the concrete unless it is quite wet.

If concrete is to be placed dry, designers should recognize this fact and show that they recognize it.

C. C. HOWELL,
Assistant Engineer, U. S. Reclamation Service.
Loma, Col.

Combined Curb and Gutter Protects Retaining Wall



SIR: While there is nothing of special merit claimed for the design of the retaining wall here illustrated, it shows how the writer adapted a concrete curb and gutter to the protection of the top of a wall built in San Antonio, Tex. In order to protect the wall from the abrasion and impact which might be expected from traffic at a sharp curve on a city street, a reinforced-concrete combined curb and gutter was built alongside the top of the wall.

By making the curb and gutter independent of the wall it was thought that the blow of a wheel against the curb would be absorbed by the gutter arm of the latter, upon which the wheel is supported. The shock would then, in turn, be so well distributed throughout the underlying earth as to deliver little or no impact to the wall, the foundation of which lies in a creek bed and is of an uncertain nature. The structure has been in service for over a year and has given complete satisfaction.

E. P. ARNESON,
San Antonio, Tex. Civil and Structural Engineer.

Manning vs. Kutter for Measuring Flow of Water

SIR: In reply to R. W. Horne's inquiry printed in the Engineering Record of Nov. 11, 1916, page 600, as to the relative merits of Manning's and Kutter's formulas for the velocity of fluid through pipes and conduits, the position may be summarized as follows:

Both formulas are empirical and designed to fit the facts ascertained by experiment. There is therefore nothing to choose between them, as they must all express the facts fairly closely, and are therefore equally reliable within the range covered by experiment. Inasmuch, however, as there is no rational basis for either, both are equally unreliable outside the range of practical experience and experimental determination.

Possibly Manning's formula is a little more flexible than Kutter's, which is rather complex in form, and perhaps the former would adapt itself better to a wider range of experiments than the latter. It should be borne in mind, however, that our knowledge of the transformation of energy in fluids in motion is extremely limited, and also that the range covered by experiment is far too limited to permit the law of resistance to be definitely ascertained.

E. PARRY,
Wellington, N. Z. Public Works Department.

Macon Develops Unique Methods for Finishing Concrete Roads

SIR: In the Engineering Record of Nov. 4, 1916, page 512, there appeared a short note which referred to the methods of construction used on concrete streets in Macon, Ga., and which probably originated here. It may be of interest to other engineers to know something more concerning the methods of construction which have proved so successful in Macon.

In the early spring of 1912 we laid a Portland-cement concrete street pavement, and this pavement without any upkeep is still in almost perfect condition, although it has been exposed to extremely heavy traffic. Since this initial venture we have laid some concrete streets each year, and since the first of July of last year we have laid more than 10 miles of concrete streets ranging from 30 to 46 ft. in width. Practically all of our downtown business alleys are paved with concrete.

After the street is brought to proper grade, thoroughly rolled, all soft or spongy places filled with suitable material and rerolled, the concrete, composed of one part Portland cement, two parts clean, sharp, carefully graded sand, and three parts hard, clean granite, varying in size from ¼ to 1½ in., is thoroughly mixed in a batch mixer. The pavement is 6 in. thick at the edge and 8 in. thick at the center. Special attention is given to the consistency of the concrete, which, after having been deposited, is spread to grade by the use of hose and shovels, and is finished by the use of hollow iron rollers 8 in. in diameter and from 4 to 8 ft. long, with handles long enough to reach a little beyond the center of the street. The rolling is done in a transverse direction, and serves to compact the surface, and at the same time to prevent any tendency to waviness in a longitudinal direction.

Immediately after the surface is rolled and before it has hardened the final finish is given by dragging an ordinary 1-in. hose over the surface. The resulting surface is one which is free from waves and bumps, and is probably not excelled by any other material.

ROLLING COMPACTS SURFACE AND ELIMINATES WAVES

The expansion joints consist of one thickness of two-ply tar paper placed, from 25 to 30 ft. apart, at right angles to the curb and extending from the bottom of the pavement to within about ⅛ in. of the finished surface. Within a few days after placing, the concrete will set sufficiently to cause a fine crack to appear immediately above the tar proper. This crack is thoroughly swept out and painted with Tarvia A heated to at least 250 deg. Fahr., thus completing the joint from the bottom to the top of the concrete. The use of this concealed joint permits the surface to be finished smoothly and avoids the objection so often raised to the use of concrete, that the joints cannot be finished to the true grade. The quality of the concrete at the joint is identical with that of the main body of the street, and the painting of the joints with Tarvia prevents them from raveling under traffic.

THE DRAGGING HOSE FURNISHES THE LAST TOUCH

About two years ago it became necessary to allow the gas company to make a great number of cuts through the pavement, the holes ranging from very small ones to some 3 ft. square. After the gas company had repaired its mains, these holes were patched by the city force, and it is now impossible to detect the places patched, except for a slight difference in shade between the old work and the patches. In patching the pavement we were careful to make the sides of the cuts as nearly perpendicular to the street surface as practical. The sides were brushed clean and were well wet, dry cement was sprinkled on the wet sides, and the 1:2:3 mixture of concrete was poured in and finished to the surface of the surrounding pavement.

Concrete is used as the pavement between street-car tracks on several miles of track in Macon. After investigating the matter in other cities and from our own experience we have come to the conclusion that this is by far the best pavement to be used for such construction. Our methods of finishing the pavement between the car tracks may prove of interest. When the concrete is brought to the top of the rail, a little truck mounted on two wooden rollers with flanges the same depth and a little broader than the flanges of the car wheels, and turned to the crown of the finished pavement surface, is rolled along the track, making grooves for the car flanges. Flange grooves constructed in this way provide a very smooth surface over the tracks and show very little tendency to wear even where they are subjected to the heaviest traffic.

J. J. Gaillard,
Macon, Ga. City Engineer.

Improving Structural Organizations

Sir: Your editorial in the issue of Feb. 17 on "Improving Structural Organizations" mentions most of the ways of increasing efficiency in such work. One of these methods, "stimulation by bonus payments for all work rapidly done," seems to be deserving of further comment. The following applies to office work, especially drafting. Designers are usually selected men paid at a higher salary and there is less call for a bonus system, especially as it is rather difficult to apply to that line of work.

The purposes of a bonus system are, first, to lower costs by increasing efficiency. This is done by differentiating between the men and rewarding each individual according to the quantity or quality of his work, thus giving him an incentive to greater effort; second, to increase wages without a corresponding loss to the employer. This amounts to giving the employee the benefit of all or part of the saving that he makes. If the stimulating effect of the bonus payments is lacking the system is not a success.

A bonus may be handled in the following ways:

1. A saving in direct expense of labor cost may be made. This is the largest saving for this class of work, and all the saving below standard or estimated time should be given to the man making it.

2. A saving in indirect or overhead expense, which is comparatively small.

3. Attention is called to the fact that there is no saving in machine expense, which saving is largely responsible for the success of bonus systems as applied to shop work.

4. The introduction of other efficiency methods, such

as standardization, planning, scheduling, etc., which a bonus system encourages the men to make use of to the fullest extent, is an indirect method of paying for bonus.

5. The value of a drawing consists of its completeness, accuracy, and the facility with which the product shown may be fabricated or erected. A lowering of the standard by rapid or careless work may result in a loss in shop or field which will more than offset the saving in time in making the drawing.

The writer has recently observed a bonus system involving about 150 draftsmen. The method used is to estimate the cost of the job by estimating the number of sheets and the cost per sheet. The work includes lists of material for the order department, erection drawings, details and checking. All saving below estimated cost is paid to the men as follows: One-half is distributed among the men on the work in proportion to time spent and monthly rate of wages, and one-half is put into a "jack pot," which is distributed to all the men employed at the end of the year. Thus, if a man makes a saving of $5 on a drawing and is working on a job with nine other men, one-half is divided among the ten men and he gets, say, 25 cents plus 2 cents in the "jack pot." While the company thus pays the men the full $5, the man who earns it receives only a small share, and the reward is too remote and uncertain to act as an incentive. If the nine other men do not make their drawings below the estimated cost, the first man receives nothing for his saving, as there is no bonus.

The largest percentage received by any of the men for a year's work, counting his share of the "jack pot," was about 10 per cent of his yearly wage, the average 4 per cent, and the minimum 2 per cent. It is a well-known fact in factory work that if the bonus offered is not close to 20 per cent for such of the men as can do the work in the estimated or standard time, few of them will make the effort necessary to earn it, and the bonus system fails of its purpose. Yet at the office cited it occasionally happens that a squad boss receives a bonus of $100 or more for three or four months' work, which is about 15 per cent, and under the present system means an excess of estimate over actual cost of 30 per cent. This usually leads to a cut in future estimates on similar work, especially if the estimator is censured for being too liberal. If the estimate is too low, the men know that they cannot make a bonus and the stimulating effect is entirely lacking. When a job is estimated as a whole, one man, as a checker, may "kill" the bonus by loafing on the job and using up all the time saved by the others.

Those responsible for the quantity of work done, as the squad boss, should share in the time saved by proper planning and rapid work. Those responsible for the quality of the drawings—the checkers and the engineer-in-charge—should not share in the time saved by the rapid work of the detailers, as there may be a slight tendency to pass things that should be corrected.

The following suggestions may be of use to those interested in a bonus system:

1. Give a guaranteed wage which is as great as if no bonus were offered.

2. In making an estimate of a job, divide it into several component parts—by function—as ordering, detailing, checking, supervising, etc.—by sheet, or by any other method that suggests itself. The purpose is to make the reward of each man or small group of men as immediate as possible not only in point of time, but also in point of application. Give what each man earns to him and not to some one else. The number of subdivisions should increase with the number of men on the job. A one-man job need not be divided.

3. Estimate accurately the cost of each part. The difficulty of doing this, even at considerable expense, will readily be appreciated, especially as the average time for making a drawing often drops when a good bonus system is installed.

4. Endeavor to give each job a bonus, say at least 10 per cent of the estimated cost, for rapid, conscientious work. Considerable dissatisfaction is often expressed by men who never get a chance to make a bonus.

5. Do not cut estimates if bonuses run higher than expected. Remember that there is always a saving if estimates run lower than before, whether wages are paid under the new system as bonus or for straight time. It is better to set an upper limit of 30 per cent or more if bonuses are too high, but that may never be necessary if estimates are carefully made.

6. The principal benefit to be derived from a bonus system is increased satisfaction, loyalty, and efficiency, on the part of employees, rather than any appreciable saving in cost to the employer.

7. A bonus system may be made an effective instrument, but it will never reach its fullest possibilities unless handled with a liberality and breadth of view which is rather uncommon at the present time.

Pittsburgh. Parker R. Whitney.

Qualifications of an Engineer

Sir: From time to time, during the last two or three years, I have read in the Engineering Record abstracts of speeches, committee reports, letters, etc., concerning the qualities in an engineer which are essential to his success. My recollection is that in every case technical knowledge was the least important of the factors enumerated.

From the point of view of a senior in a school of civil engineering, there seems to be a lack of consistency between what engineers say in theoretical discussions and what they do in actual practice. Now, I am a youngster, nineteen years old. Most of these years have been spent in the public schools and in college, so that the charge of inconsistency which I am making may be the result of my ignorance. I myself am inclined to think so, and the only reason I am writing is that a reply to this letter may appear in the Engineering Record and set me right. Let me tell you why I think that employers say one thing and do another. I could give instances of other men, but my own experience this summer is perhaps more convincing, because it is personal. I went to see a number of engineers about a job for the summer, and my lack of engineering experience put me out of the running every time. I went to a firm of nation-wide activity, where, I was told, there was a vacancy in the bookkeeper's staff. I told the head bookkeeper that I knew nothing about bookkeeping. Still he said he would try me. Two months later I received a call from the head of the eastern division to take a position in his office. Now, I don't tell you this to prove to you what a bright little boy I am, not at all. The point I am trying to make is this: If, as I have read repeatedly, and as has been told me by my professors, it is true that what counts in an engineer is not so much what he knows about stresses and trusses and detailing, and so on, but his character, his adaptability, his capacity for hard work—I say, if this is true, why is it, then, that when I come to apply for a job I am not examined for the purpose of judging of my character, of my adaptability, or of my capacity for hard work (by actual test)? No, employers don't ask about these things, which engineers say are the most important things. What they ask me is: "How much do you know?" For to ask how much previous experience you have is to ask what you know.

To be sure, it is much easier to judge an applicant by his experience than by such intangible things as character, adaptability, and the rest of the qualities mentioned by writers and speakers on the subject. That is indeed a problem. The only solution that presents itself to my mind is to give a man a chance to reveal the necessary qualifications, or his lack of them, a solution which men who know more than I do about actual conditions may consider impracticable.

As I say, the views I have expressed may be wrong because of my ignorance, but I want to learn. Perhaps someone will reply and clear the matter up for me.

HARRY BERLIN,
New York City. Student, New York University.

The Contractor's Risk

SIR: The loss of the first-class protected cruiser Milwaukee, which went ashore on the California coast near Eureka on Jan. 13, affords a striking illustration of the allowance that must be made for the risk element in considering bids on engineering work. More and more frequently nowadays is heard the announcement, "All bids rejected; work will be done on the day-labor basis." Often municipalities without extensive experience in construction work call for bids and then reject them, placing reliance on some scheme for executing the work for less than the contractors' price. This may be a wise course in some cases, but it should always be borne in mind that the bidder assumes the risks, and adequate allowance for this element must be made.

The loss of the Milwaukee is not cited as a case of inexperience in handling the work but rather as illustrating insufficient allowance for risk. A $4,000,000 cruiser was lost in a vain effort to accomplish work on which five contractors had made bids ranging from $60,000 down to $18,000.

The situation in this case developed as follows: The submarine H-3 recently went ashore in the fog near Eureka, and after a number of unsuccessful attempts to get it off into deep water bids were called for on the work of salvaging the submarine. Five offers were received, including a plan to haul the submarine across the sand bar into Humboldt Bay, which involved practically no risk. It was decided, however, that another effort would be made by navy officials to float the boat, using more powerful vessels than had previously been employed.

FOUR MILLION DOLLAR CRUISER LOST WHILE ATTEMPTING $60,000 SALVAGE JOB

Accordingly, the cruiser Milwaukee and the monitor Cheyenne, accompanied by the navy tug Iroquois, were dispatched to the scene. On Jan. 13 they got a line aboard the submarine and attempted to pull it through the surf. The Milwaukee was nearest to the submarine, the other two boats, farther off shore, having lines to the Milwaukee. Pulling against a dead weight in the rough sea caused the line between the Cheyenne and the Milwaukee to part. After this the drag of the heavy cable, which was about 2 in. in diameter and almost half a mile long, was more than the Milwaukee and the Iroquois could withstand and both vessels, realizing that they were being drawn inshore, attempted to slip the cables.

The Iroquois succeeded in getting free, but the Milwaukee, while endeavoring to cut the heavy cable with cold chisels, was drawn into the breakers and driven broadside on the beach, where it was exposed to a destructive pounding by the waves.

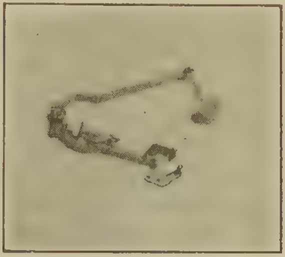
An inspection of the cruiser below decks shortly after indicated that the stanchions had begun to give way and that there was practically no hope of refloating the vessel. Plans were later made for taking off such equipment as could be removed while the vessel lay in such an unfavorable position. It is safe to say, however, that the loss will amount to several million dollars; and only skillful work prevented loss of life in rescuing the 435 men aboard the unfortunate cruiser.

San Francisco. K. T. Roberts.

Fits Planimeter With Tongue, Making the Tracer Point Visible

Sir: I am inclosing a photograph and a sketch of two devices constructed by the writer which have saved considerable time and annoyance.

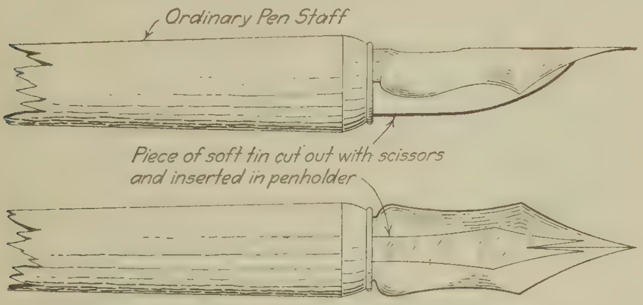
The photograph shows a small planimeter as revised. When bought, the tracer point was attached to the arm by means of the tongue shown just below the instrument proper. This tongue curved toward the operator, so that the point was hidden three-fourths of the time, unless the operator leaned his head over in an uncomfortable position. The new tongue was made from a piece of brass "lead" or "rule" used in a printing office. It was sawed to approximate shape and filed smooth. Holes were drilled large enough to allow sufficient play for adjusting, and the tongue was then inserted in place of the old one.



NEW PLANIMETER TONGUE CURVES FROM OPERATOR

By actual test the operator was able to do more than 25 per cent more work when using the instrument as revised, and claimed to be less tired at night.

The sketch shows a piece of tin cut into proper shape and inserted into a lettering penholder to make a "fountain" pen of the ordinary point. It is so simple that I am almost ashamed to call attention to it, but its convenience and cheapness are worthy a trial. This "fountain" pen may be filled with ink above the eye or slot in the pen without feeding too freely. The ink retainer is easily removed for cleaning.


Ordinary Pen Staff
Piece of soft tin cut out with scissors and inserted in penholder

PIECE OF SOFT TIN CONVERTS ORDINARY PEN INTO "FOUNTAIN" PEN

R. T. Brown,
Engineer, Board of Road Commissioners.
Davidson County, Lexington, N. C.

Building Levees with Bucket Dredge

Sir: The suggestion made by Arthur M. Shaw in the article on page 730 of the Engineering Record of Dec. 16, 1916, regarding the employment of grab-bucket dredges for making levees along the Mississippi River reminds me that this method was used by us more than 50 years ago in building dikes along the canal from the North Sea to Amsterdam, Holland. If my memory does not mislead me, equipment of this type was especially designed for the work by a Mr. Burgges, one of the employees of Merfer, Treeman & Company, the contractors for this canal. It was also on this work that concrete was used to a large extent for the first time since the introduction of Portland cement for constructing sea walls. These walls extended for a long distance at right angles with the beach into the North Sea, forming the entrance to the canal.

Juan I. de Jongh,
Guatemala. Consulting Engineer.

[The Engineering Record understands that Mr. Shaw referred to this method as having been in general use, but as being barred on the construction of levees for the United States Government by clauses in the specifications adopted by the government as standard for this work.—Editor.]

Quartz-Gravel Concrete and Fires

Sir: Your editorial comment with respect to Professor Woolson's paper on "The Responsibility of Quartz for Disruptions in Concrete Subjected to Fire," page 127 of the issue of Jan. 27, draws attention to a very interesting subject.

At the time of the fire in the Edison factory at Orange, N. J., the writer made an examination by permission of Mr. Edison and found that not only were some of the larger aggregates injured by fire, but further that some of the smaller sand grains showed what was apparently expansive disruption. Some photographs of these features were exhibited in the discussion of the Edison fire report at the American Concrete Institute meeting at Chicago in 1915. Perhaps as illuminating and significant an observation on this subject as could have been made was that of Mr. Edison on reviewing the findings of this examination: "I don't know whether the sand grains have cracked or not, but I know there is no rock that will not spall under heat." Considering quartz gravel and sand grains as but particles of rock of smaller size, is it not reasonable to expect the disruptions which Professor Woolson has noted?

Nathan C. Johnson,
New York. Consulting Concrete Engineer.

Greatest Coal Production in 1916

Coal-production records were smashed in 1916, when the output was about 597,500,000 tons, compared with the previous high record, established in 1913, of 570,000,000 tons. The quantity of bituminous coal mined was 509,000,000 tons, an increase over 1915 of 66,500,000 tons, or 15 per cent, according to estimates by C. E. Lesher, of the U. S. Geological Survey. The quantity of Pennsylvania anthracite was about 83,312,000 net tons, a decrease of 600,000 tons.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

Sheet-Pile Outriggers Bolted to Crane for Moving with Heavy Loads

By H. W. STREULI
Schenectady, N. Y.

SHEET-PILE outriggers bolted to the underframe of a locomotive crane, as shown in the photograph, were used in constructing a section of the Passaic Valley sewer to enable the crane to move along the track without delay in handling material excavated with the grab bucket, and still be able to handle the loaded bucket safely at maximum radius.

The outriggers were installed after the crane had been overturned, involving a loss of $500 and three days' working time. In hoisting a 1-yd. loaded bucket the operator made an error in his levers, turning the bucket loose. As there was no one under it, he should have allowed it to drop, but attempted to catch it. The momentum of the bucket at the maximum radius of the boom turned the crane over into the hole.

The rail clamps supplied by the manufacturers of cranes are not of much use in a situation like that in which this crane was working, where the track is often temporary, with light rails, poor ties and no ballast. Moreover, in order to dump the material it was necessary to move the crane a short distance from digging position, with each load under overhead wires. To stop to fasten and take off these clamps with every load, and at the same time do efficient work with the crane, was out of the question.

The ties under the track were therefore replaced at 8-ft. intervals with 10 x 10-in. timbers 18 ft. long, thoroughly ballasted with crushed stone and supported at the ends next the excavation on blocking from the 40-ft. steel sheeting which lined the trench. Heavy rails were spiked to the ends of these timbers parallel to the track and 5 ft. outside the running rails on each side. Two 16-ft. pieces of steel sheet piling 13 in. wide and weighing 40 lb. per foot were bolted to the crane truck on each side with eight 1-in. bolts apiece. These sections projected beyond the guard rails on each side, as shown in the photograph. They cleared both the running and the guard rails by about ¼ in. Being extra pieces already on hand, they were applied without difficulty and at little cost, compared with procuring channels or I-beams for the same purpose.

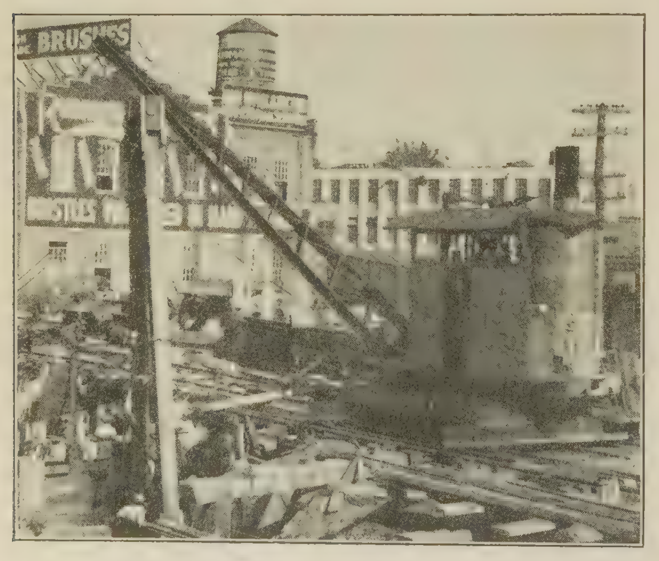
The method, while insuring the crane against turning over under any conditions, allowed free movement along the track and caused no delays for blocking or otherwise anchoring the crane when necessary to operate it at maximum radius.

IF A CONTRACTOR could hide his job under a bushel, we'd understand why some of you don't "let your light so shine," etc.

But it's perfectly obvious that it can't be done. It would take a three-ring circus tent to cover even an ordinary job. And even then, human nature is so curious you'd have to arm a gang with stakes to keep people from sneaking under the flaps.

So as long as everyone is going to see your stunt anyway, be a sport and give it a place in the parade in

HINTS FOR THE CONTRACTOR



SHEET-PILE OUTRIGGERS BOLTED TO CRANE TRUCK

The Elusive Cement Sack

THE VARIED CAREERS pursued by those cement sacks that are numbered among the missing when the shipments of return bags to the mill are tagged have been epitomized in a ditty entitled "One More Sack Is Gone," put forth by the Universal Portland Cement Company, and sung to the tune of "John Brown's Body" at select gatherings of the cement industry:

The Polak needs an apron to protect his dainty waist;
He beats it to the pile where all the empty sacks are placed,
Picks out the best that he can find and then skidoos in haste—
And one more sack is gone.

Chorus

Some one's going to lose the money,
Some one's going to lose the money,
Some one's going to lose the money,
For one more sack is gone.

The Dago has to work on ground that is a trifle wet,
But will he get pneumonia? No! he will not—you can bet!
He wraps his feet in empty sacks—they never stopped him yet—
And one more sack is gone.

The Hunkie wants a handy bag for carrying his tools;
The sacks are lying all around—there are not any rules
To keep the men from stealing them—they teach it in the schools—
And one more sack is gone.

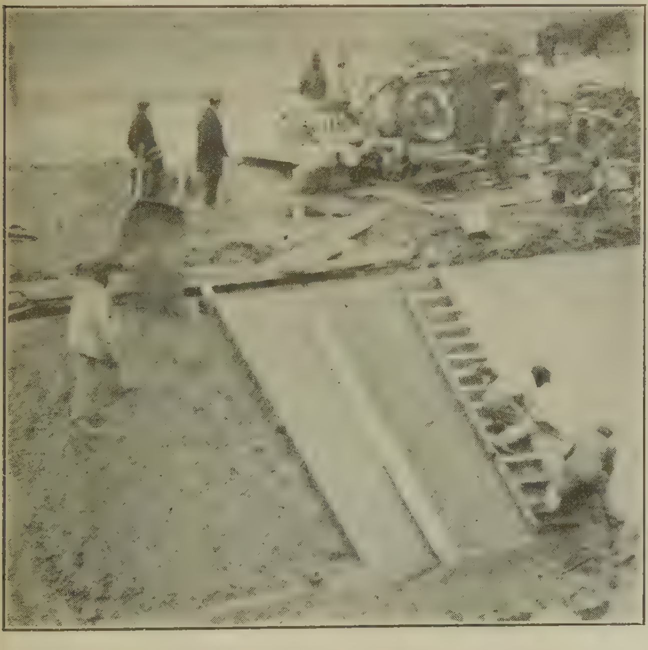
The Ginny slips, and though, by luck, he isn't badly hurt,
He sees upon his lingerie a tear and maybe dirt.
He steals a sack and takes it home to make another shirt,
And one more sack is gone.

Pat Levee-Slope Concrete Smooth with Plank Before Finishing

By ALBERT S. FRY
Memphis, Tenn.

IN PLACING concrete on the slopes of the Gayoso Bayou in Memphis the Koehler Brothers, Fowler Construction Company found it necessary to mix the concrete very dry in order to make it stand on the 1 to 1 slope. After raking the concrete down to the required 6-in. thickness the surface was quite rough and had a sort of mealy appearance.

To bring this surface to a finish that could be troweled, a long plank laid flat on the slope and raised and dropped with a wire by a negro laborer, who kept his foot on its lower end to steady it, was used. The wire was attached about the middle of the plank. The board was sufficiently heavy when dropped through the short distance it was raised by the wire to pat the concrete down into a fairly smooth surface.

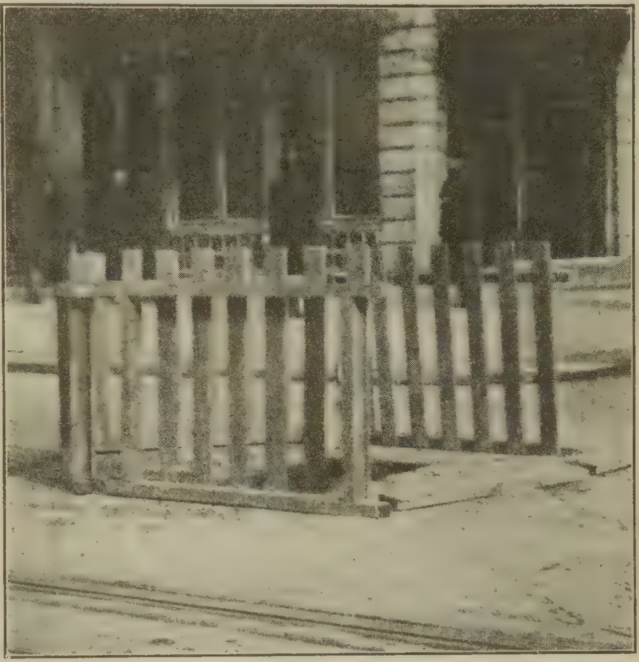


PLANK FLAPPED UP AND DOWN WITH A WIRE USED TO SMOOTH CONCRETE

The final finish was given the slope by two laborers working from a ladder laid on it. A thin mortar was placed on the surface already patted down and then floated to a smooth finish. The ladder was held in position and prevented from sinking into the concrete to any extent by short pointed projections on the under side at the top end.

Jointed Fence Guards Holes in Street Decking

HINGED FENCES like that shown in the photograph may be spread out to cut off half the roadway or contracted to guard a small opening without blocking more than a few feet of the roadway. When folded together, they occupy very little space and can readily be stored or handled. Besides being a great deal more convenient and adaptable than the horses commonly used for the same purpose, these picket fences, painted a bright red, are much more visible and therefore less apt to be run through accidentally. Their neat appearance and the fact that they do not block any more of the street or sidewalk than is absolutely necessary also make them much less objectionable to the public than the usual type of obstruction.



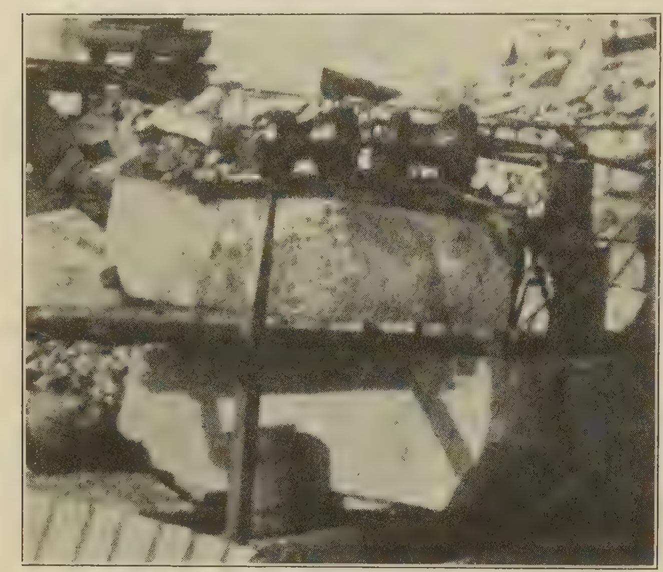
JOINTED FENCE GUARDS HOLES OF ANY SIZE

The sections of these fences, which have been built and are being used on a section of the new Broadway subway in New York City by the Holbrook, Cabot & Rollins Corporation, consist of a top and a bottom piece to which the pickets are nailed, with a post at each end, just outside which is a long bolt extending through both pieces. The sections are connected to make a fence of any desired length by light plates at the top and bottom, free to turn around, a bolt through each end securing them to the fence. This gives a double hinge at each joint and makes it possible to fold the fence flat against itself. Most of those used on this section are made up by hinging four sections together.

Baby Hoists Turn Bullwheel of Large Derrick When Swinger Breaks

By H. L. HICKS
Great Neck, N. Y.

TWO LITTLE tugger portable air hoists were substituted recently for the regular swinging gear used to operate a large quarry derrick in Vermont while the regular engine was being repaired. As the derrick—the largest of those in use—was important to continuous operation, the quarry was practically tied up by an accident to its swinger. The superintendent, however, quickly improvised a new swinging gear by bolting the two "little tuggers" side by side to 2-in. planks, which in turn were changed to two large blocks of granite, as shown in the photograph. The lines from the hoists were led to opposite sides of the bullwheel, one being used to turn the derrick in one direction and the other to swing it back. This improvised arrangement kept the derrick in operation more than a week while the regular swinging engine was being repaired. In ordinary service one of these little hoists is used to overhaul the heavy cable from one of the derricks across the quarry pit, as described in the Engineering Record of June 24, 1916, page 843, while the other is used in lowering steels and light loads into the pits.



TWO SMALL HOISTS MAKE ONE SWINGING GEAR

The rig described was used in the Montpelier (Vt.) quarry of the Wetmore & Morse Granite Company.

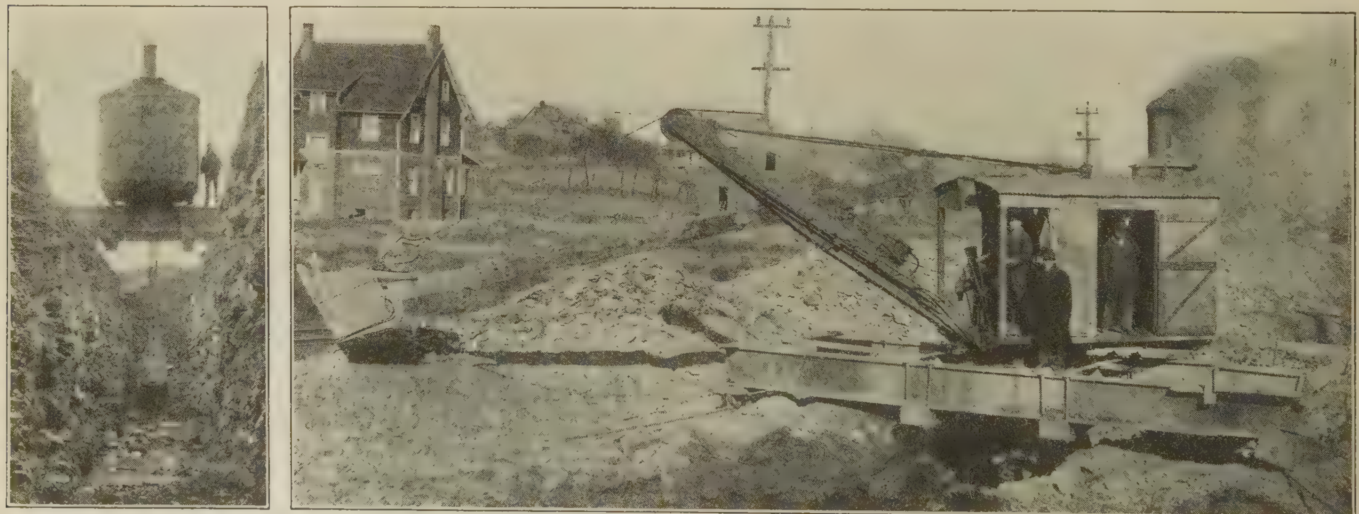
Snow and Salt Keep Ice from Freezing Around Bridge Falsework

By LOUIS G. ARNOLD
Assistant Superintendent, Wissota Dam,
Chippewa Falls, Wis.

DURING the removal of the highway bridge over the Chippewa River to permit the placing in service of a new reservoir of the Wisconsin-Minnesota Light & Power Company, the lake surface, covered with a thick layer of ice, was continuously rising. If this ice had been allowed to freeze to the falsework used in the removal of the bridge, a serious accident might have followed. At first a great deal of time was spent in cutting the ice away from the falsework, but later it was found that the same result could be accomplished by filling the water around the piles with soft snow sprinkled with barrel salt. In this way the labor cost of cutting the ice from the piles was practically eliminated.

Steel Frame Gives Wide-Span Support for Steam Shovel Over Trench

TO MINIMIZE caving where a wide, deep trench is being built, Miller Brothers, contractors, of Youngstown, Ohio, mounted their Erie steam shovel on a bridge of steel I-beams instead of the usual timber platform. With the latter, 25 ft. is about the maximum length, but the machine shown in the pictures rests on I-beams 35 ft. long. The shovel is secured to wooden timbers suspended below the I-beams by U-bolts. By this arrangement the center of gravity of the shovel is lowered and tipping obviated. The machine is moved forward over rails laid at the very ends of the frame so as to concentrate the load as far from the edge of the trench as possible.



FRAME OF LONG I-BEAMS SUPPORTS STEAM SHOVEL SAFELY IN EXCAVATING WIDE TRENCH

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

James H. McGraw, Technical Publisher

What the New President of the McGraw-Hill Publishing Company, Inc., Has Contributed to the Progress of American Technical Journalism

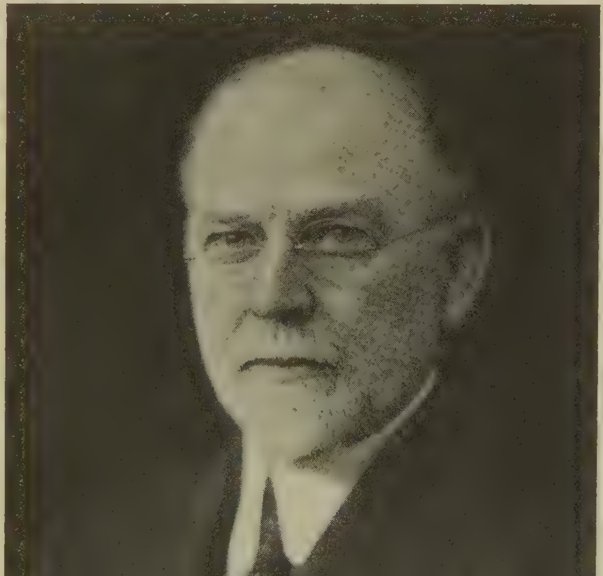
Thirty-three years ago a young man, his fingers fidgeting with the buttons on his coat, faced an audience in the Normal School of a little up-state town in New York and delivered the valedictory address for the graduating class. Last week the same man faced another audience—the 257 employees of the great technical publishing organization which his genius had created and developed into an instrument of far-reaching power in the engineering field. All the indecision of his school-boy oratory was gone. This time he had a real message to tell—a message which chronicled the birth of the world's largest enterprise devoted to the production of technical and business papers. By consolidating his own business interests with others of similar magnitude, James H. McGraw, president of the newly formed McGraw-Hill Publishing Company, Inc., which will control ten engineering periodicals, each the leader in its field, becomes the dominating influence in American technical journalism.

Will Control Ten Papers

To engineers the commanding position of the new organization can best be indicated by an enumeration of the papers which will be issued under the McGraw-Hill management. There are, first, the Engineering Record and Engineering News, both enjoying an international reputation, which will be consolidated into a new weekly journal—the Engineering News-Record. The consolidated paper, following the policies of its two constituents, will be devoted to the field of civil engineering and construction. But all of the other major engineering fields—electrical, mechanical, mining and chemical—will be served by such influential mediums as the Electrical World, Electric Railway Journal, Electrical Merchandising, Metallurgical and Chemical Engineering, The Contractor, American Machinist, Power, Coal Age and the Engineering and Mining Journal.

Into the historical texture of this great publishing project, started more than a score of years ago, the life of James H. McGraw is intimately interwoven—in fact, the business is the physical embodiment of his ideals and thinking. Born in Panama, Chautauqua County, New York, in 1860, Mr. McGraw spent his early days on his father's farm, attended the local schools and was graduated in 1884 from the Fredonia Normal School as valedictorian of his class. Even as a young man, his qualities of leadership asserted themselves. As president of his class and leader of the debating society, he soon became an important factor in the life of the school.

President of the Newly Formed McGraw-Hill Publishing Company, Inc., Controlling Ten Leading Technical Journals



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JAMES H. McGRAW

For a few years after graduation he taught school in several towns in western New York, but his ambition for bigger things made him dissatisfied with this work. He resigned and came to New York City, where, as representative of the American Railway Publishing Company, he gained a foothold on the lowest rung of the publishing ladder.

Enters the Publishing Business

For a while Mr. McGraw served as Philadelphia representative of the American Railway Publishing Company, which controlled three papers, the Street Railway Journal, Power and the American Journal of Railway Appliances. His early work in the publishing business was in the circulation and advertising departments. Here he developed that close acquaintance with the field which was to become such a valuable asset in his later work.

These were the days of the horsecar, and when electric traction was first proposed Mr. McGraw was quick to see its possibilities. This was his opportunity; even in early life he was a man of broad vision and enthusiasm. It is characteristic of his power that in 1888, only a couple of years after he had entered the business to which his life was to be devoted, he became the sole owner and publisher of the Street Railway Journal.

His acquisition of this property merely started him upon his career as a publisher. The rapid development of electric traction and the consequent obsolescence of the horse car placed him in a strategic position. He had a great influence in the field, and he used it always for the upbuilding of the industry. In fact, it is generally recognized that no one has done so much for the electric railway business as he. He worked not only through his paper, which later was renamed the Electric Railway Journal, but also through the American Electric Railway Association, in whose work he has taken an active part.

With the growth of electric traction, other developments occurred. Great industries were springing up for the manufacture of electric equipment of all sorts. To so keen an observer as Mr. McGraw, these beginnings of an electrical industry, which was soon to become colossal in its proportions, were significant. Again his vision pictured an immense field for a technical journal. With this conception in mind, he purchased in 1896 Electrical Industries, which he renamed the American Electrician, a monthly periodical devoted to electrical and mechanical engineering. Three years later, in 1899, he acquired the two leading electrical journals—the Electrical World and the Electrical Engineer, both of New York. These, with the American Electrician, were consolidated into one publication, the Electrical World, now the leading journal of the electrical industry.

Engineering Record Purchased

To control these properties the McGraw Publishing Company was incorporated in 1899, with Mr. McGraw as president and controlling stockholder. Already a factor in the street railway and electrical fields, he struck out into new territory in 1902, when he bought the Engineering Record, a weekly journal devoted to general engineering, established in 1877 as the Plumber and Sanitary Engineer. Backed by his thorough knowledge of the technical publishing business and his rapidly growing resources, Mr. McGraw soon made the Engineering Record a journal of national influence in the civil engineering and contracting field.

At about the same time as the Engineering Record's purchase was effected, Mr. McGraw started in Philadelphia a new publication known as Electrochemical Industry, published monthly. This paper was later removed to the New York office of the McGraw company, and beginning with January, 1905, the scope and name of the paper were enlarged. The journal became Electrochemical and Metallurgical Industry. In 1910 the name was again changed to Metallurgical and Chemical Engineering, and beginning September, 1915, the paper was issued semimonthly, instead of monthly.

A shrewd observer of developments in the electrical field, Mr. McGraw saw, last year, the need of two papers instead of one—the Electrical World. Two groups of readers had developed—one, the technically trained electrical engineer, and the other, the electrical contractor and the merchant engaged in the sale of the various electrical devices placed upon the market for use in the home. Mr. McGraw decided to maintain the Electrical World as the technical paper of the electrical industry and to issue another publication devoted exclusively to the merchandising of electrical equipment. In 1916, therefore, he purchased Electrical Merchandise and Selling Electricity, and changed the name to Electrical Merchandising, the first issue under the new name and management appearing July 15, 1916.

During the same year a somewhat similar problem arose in the field of the Engineering Record. It was felt that the Engineering Record, as a national publication, could not well serve all elements in the contracting field. It was decided, therefore, to issue a new paper, and Mr. McGraw accordingly bought The Contractor and The Contractor's Review, both of Chicago, and merged them into one journal, The Contractor. This paper is published fortnightly, and the first issue under the new management appeared Jan. 15, 1917.

Constructs His Own Building

As the properties of the McGraw Publishing Company developed, it became apparent that the quarters formerly occupied at 114 Liberty Street, New York City, would be inadequate. Mr. McGraw decided to have a building of his own, and in 1906 began the erection of the eleven-story reinforced concrete structure at 239 West 39th Street, which has been the home of the Engineering Record and his other publications. It is significant of the growth of the business that only a few years after the new building was finished, a second one of the same size was constructed as an addition on the west side of the original structure. With the consolidation of the McGraw and the Hill publishing companies the organization will have available the present McGraw building on 39th Street and the imposing structure erected by John A. Hill for his papers, at 10th Avenue and 36th Street.

So much for the business achievements of James H. McGraw. He is a man who has carved out his own career—a man in whom vision and courage are linked with unusual qualities of leadership and organization. Never an editor himself, he has, nevertheless, always held rigidly to the policy that the success of a technical journal must be built around an editorial staff which knows no instructions beyond those of giving the reader what is best, irrespective of any other consideration. He is essentially a man of action, a doer of big things. His mind is unerring in its grasp of essentials. He is never hasty in arriving at decisions, but adheres to them persistently when once formed. He is a worker of enormous capacity and has a memory which is almost uncanny in its retentiveness. Time and again he has predicted the results of elaborate investigations by his associates, involving pages of statistics, with an accuracy that is startling. These predictions, however, were not guesses, but matured, even if quickly formed, judgments based on a most intimate knowledge of the publishing business.

The new organization, publishing the dominant papers in all the great engineering fields, presents a still wider scope for his extraordinary abilities.

Engineers of Southwest to Form Society

A society of engineers of the Southwest is to be formed at a meeting called for March 8, 9 and 10 at El Paso, Tex., at the instigation of the faculty of the school of engineering of the State College of Agriculture. Arizona, Texas and New Mexico men are to be included in the new society. A preliminary meeting at the El Paso Chamber of Commerce, called by Dean A. F. Barnes, Dec. 27, started the plans for the new society which is to be launched this month. The constitution committee has practically completed its work, and the following are extracts from the proposed document:

"The object shall be the professional improvement of its members; the encouragement of social intercourse among engineers; the advancement of engineering knowledge, education and practice, and the maintenance of a high professional standard among its members.

"Second, it was thought best to provide for three classes of membership—namely, the full member, who is an engineer not less than 27 years of age and who has been in active practice in his profession for at least six years; the associate or junior member, who shall not be less than 18 or more than 30 years of age and who shall be actively practising or a student or graduate of a recognized technical school; the affiliated, who shall be a person interested in the objects of the society and who shall by practical experience qualify to co-operate with engineers, but who is not a professional engineer.

"Third, the constitution provides for an initiation fee of $5 for members, for associated $3 and for affiliated $2. The annual dues for members are $3 and for associates and affiliated $2. Fourth, the constitution provides for semi-annual conventions, the first on the third Wednesday in October, to be held in El Paso, Tex., and the second to be held at such time and place as the board of directors may determine."

Applications for charter membership will be received up to the time of the convention by the following, who comprise the temporary membership committee: J. F. Woodyards, Jr., Box 1117, El Paso, Tex.; Dean G. M. Butler, Tucson, Ariz.; S. O. Andros, Albuquerque, N. M., and Dean A. F. Barnes, State College, New Mexico.

Holds First Washington Meeting

The first Washington meeting of the Western Society of Engineers was held recently. It was the forerunner of future meetings at which the Washington Award, established by John W. Alvord, is to be presented. Five short papers were presented on engineering work in Washington's time: "Surveying," by Ernest McCullough; "Iron and Steel Industry," by J. N. Hatch; "Hydraulic Sanitary and Municipal Engineering," by C. B. Burdick; "Roads and Pavements," by A. N. Johnson, and "Shipbuilding," by John G. Kreer.

The Hill Publishing Company and Its Founder

Organization Which Consolidates with McGraw Company Controls Five Prominent Engineering Papers

The history of the development of the Hill Publishing Company, like that of the McGraw Publishing Company, Inc., with which it has become consolidated, is built largely around the efforts of one man. The late John Alexander Hill, founder of the house which bore his name, began his publishing career by the acquisition of Locomotive Engineering, a paper on whose editorial staff, a few years before, he had been given a position as editor. With Mr. Hill at its head, the journal soon became successful. Hardly had it become firmly established when Mr. Hill sold it and purchased the American Machinist, laying the foundation for one of the largest enterprises in the field of technical publication ever established.

Since its formation in 1902, the Hill Publishing Company has reached a position in the front rank of technical journalism. It had its beginning in the consolidation of the American Machinist Press, publisher of the weekly American Machinist, and the Power Publishing Company, publisher of the monthly Power. In 1905, the weekly Engineering and Mining Journal was purchased. In 1908 the semi-monthly paper, The Engineer, of Chicago, was consolidated with Power and the latter paper was made a weekly. In 1911 Engineering News was purchased. A new weekly paper, Coal Age, was started in October, 1911, its field being coal mining and coke manufacture. Four years later the Colliery Engineer, published in Scranton, was bought and consolidated with Coal Age. The Mining and Engineering World, published in Chicago, was acquired in December, 1916, and consolidated with the Engineering and Mining Journal.

Mr. Hill's enterprises proved so fortunate and expanded so rapidly that it became necessary to provide ample quarters for them, and in 1914 he completed the large building at 10th Avenue and 36th Street, New York City, where his five papers were edited and printed. To this building Mr. Hill devoted the last years of his life, planning at every point to suit the convenience and economy of the printing and publishing business, and at the same time providing for the safety, comfort and health of the army of workers which he employed.

After Mr. Hill's death, Arthur J. Baldwin was appointed to the presidency of the Hill Publishing Company. Mr. Baldwin, the new vice-president and treasurer of the McGraw-Hill Publishing Company, Inc., is a lawyer by profession and for many years was closely associated with Mr. Hill.

For the ten years before becoming the administrative head of the Hill Publishing Company, Mr. Baldwin's attention had been directed almost entirely to business problems. Among the offices he held were those of treasurer of the Rogers Silver Plate Company; treasurer of the Borough Development Company, which held a contract to remove ashes from Brooklyn; treasurer of the Boston Development & Sanitary Company, which handled all the garbage and ashes for the city of Boston; vice-president of the Automatic Fire Protection Company, and secretary of the Mississippi Wire Glass Company.

New Vice-President and Treasurer of the McGraw-Hill Publishing Company, Inc.

ARTHUR J. BALDWIN

For many years Mr. Baldwin had been Mr. Hill's business adviser and confidant. This position of intimacy between the two men enabled Mr. Baldwin to enter upon his work as president of the Hill organization with a thorough grasp of its details and policies.

Road Men Urge Interstate Route

Resolutions urging upon the legislatures of Idaho, Montana and Washington the desirability of an interstate highway route by way of Missoula, Lola Pass and Lewiston, Idaho, were adopted by the Interstate Highway Association at its recent convention in Pasco, Wash. Additional resolutions urged upon the legislatures the necessity for generous appropriations for sparsely populated sections, provisions for road maintenance, a uniform system of highway signs established by law, a combination of northwest states for advertising natural resources and scenic advantages, and the organization of committees under the auspices of the association for the beautifying of highways by planting trees and shrubs. Lewiston, Idaho, was selected as the place for the annual meeting next November.

Garage Roof Collapses 79 Days After Concreting

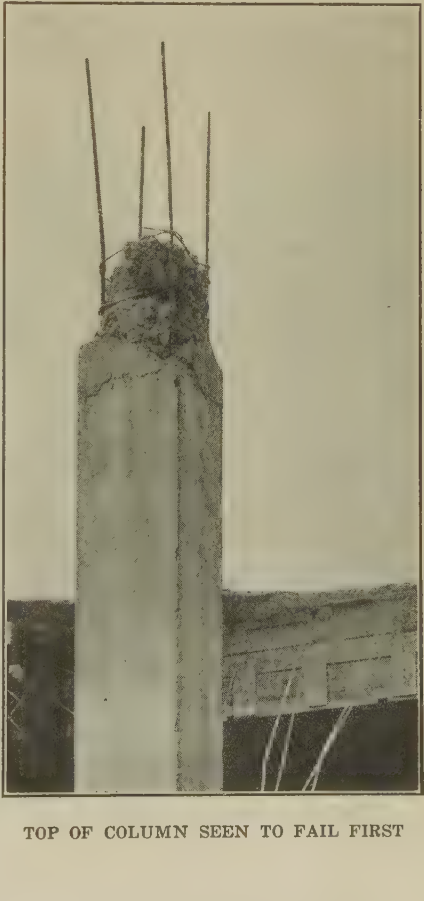
Long Drying in Freezing Weather Before Cement Could Set Precedes Accident at Omaha

By A. C. AREND
Omaha, Neb.

The fatal collapse on Feb. 27 of a reinforced concrete garage roof in Omaha, which was poured 79 days before, on Dec. 10, is probably traceable to the drying out of the concrete during this long interval when the temperature was close to or below freezing and during which there is no evidence of the concrete having had an adequate opportunity to set. The accident occurred two days after a sudden rise in temperature and about the time the forms under the collapsed portion had been removed and the temperature inside the building raised for the operation of placing floor finish. The building, that of the Sample-Hart Company, is a two-story brick and reinforced concrete structure, intended for an automobile sales and service station. The contractors for the building, the Home Builders, Inc., erected the forms and placed the concrete.

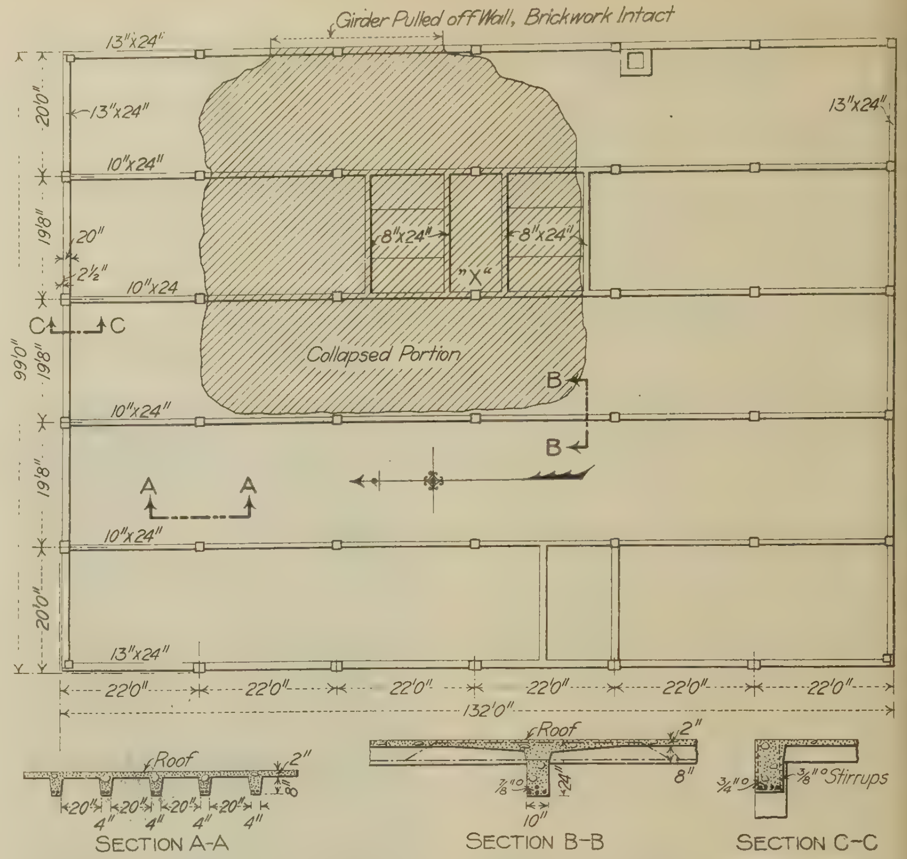
Eyewitness to Accident

About four o'clock in the afternoon of Feb. 27, 1917, nine contiguous panels collapsed, killing one workman and injuring two others, one very seriously. The superintendent has stated that a workman had come to him with the statement that a piece of concrete had fallen from a beam and had hit him on



TOP OF COLUMN SEEN TO FAIL FIRST

the shoulder. Turning from what he was doing, he started to the portion of the building where the concrete had fallen, and as he was looking at the column top marked X on the plan, from near which the concrete had fallen, he saw it begin to crush and fall away. Suddenly the whole thing came crashing down, leaving conditions much as shown in the photograph. The collapse occurred so quickly that he did not have time to issue a warning cry.



COLLAPSE OF ROOF OVER SHADED AREA STATED BY WITNESS TO HAVE BEEN INSTANTANEOUS

Temperature Near Freezing

This portion of the roof was poured on Sunday, Dec. 10, 1916, without the knowledge or consent of the city building department. The temperature was practically below the freezing point all day, and toward evening it became cloudy and colder. Apparently there was no attempt made to heat the materials properly, but the superintendent states that under the roof salamanders were kept burning the following Monday and Tuesday. He further stated that the only frozen concrete which he discovered was a top layer, about ¼ in. thick, on the roof surface, and that this was removed and replaced with good cement mortar troweled on. The weather after the date of pouring was usually at freezing or colder and has been below zero many times.

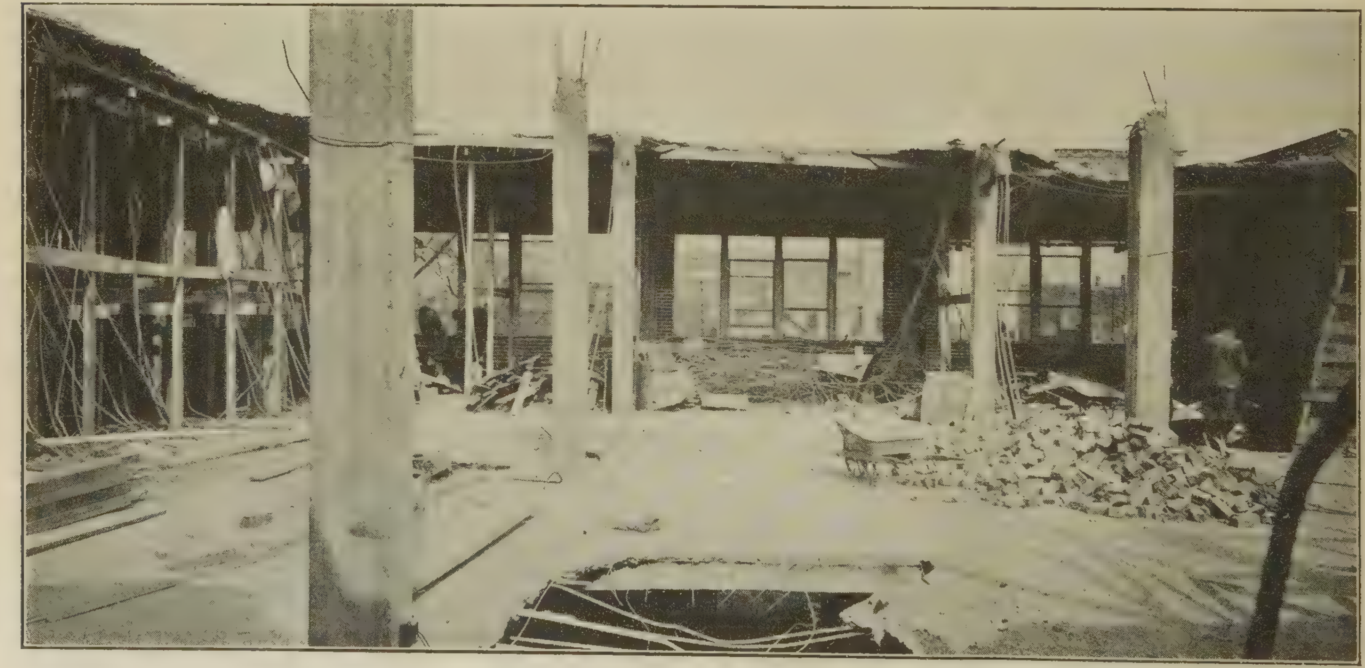
Top of Columns Poured with Roof

The columns had been poured a day or two previous to the slab, and evidently stopped about 18 in. below the girder bottoms. The upper portion, poured with the roof system, seems much more porous and loose than the other work. The impact of the falling roof where skylights were located was sufficient to break through the concrete of the floor below, but the reinforcing steel held the shattered floor concrete so that no collapse of this floor occurred. The roof fell through a distance of about 15 ft. A portion of this shattered concrete was removed, leaving a hole through which the débris from the roof was shovelled to the ground below.

Concrete Very Dry

When the photographs were taken practically all of this débris had been so disposed of and was being removed in wagons. There was one large loose pile resembling dry mixed materials, but hardly as damp in appearance as that usually is. Many pieces of crushed rock were entirely free of cement. On the floor above were still several large pieces of the wall girders. These were being broken by means of sledges and drills. This concrete had a well-mixed and rich appearance, but gave the impression of concrete which had been frozen hard and was warming up.

Two days previous, on Feb. 25, the weather had suddenly turned very warm, the thermometer going to 68



CONCRETE AROUND EDGES OF BREAK STATED TO BE IN CRUMBLING CONDITION—FLOOR BELOW WITHSTOOD HEAVY IMPACT WITH ONLY LOCAL PUNCTURES deg., maximum, at 4 p. m., and it is reported that salamanders had been kept burning under the roof for several days. The finishing of the second floor had begun on the morning of the day of the failure, and at that time practically all shoring had been removed from the roof and the building brought up to a suitable temperature.

The portions of the roof still standing have a very dry appearance, and the shattered concrete at break lines is usually dry and loose. Apparently no attempt had been made to supply moisture to compensate for the drying action of the artificial heat and the dry weather.

No Broken Bars Found

The main slab of the second floor between joists is generally 2 in. thick, except adjacent to the carrying beams. Several holes were punched through these thin slabs by the falling material, but in all cases the reinforcing material held, thus preventing collapse of this floor. A careful examination of the reinforcing material from the collapsed portion of the roof failed to disclose a single case of broken bars, in spite of the fact that a great proportion of the bars were bent into all manner of shapes and many of the bent bars almost entirely restraightened at the bends. While before the photographs were taken much of the reinforcing steel had been cut away, after the collapse the reinforcing steel was still in place, so far as the ends projecting into the unfailed portions were concerned.

The large photograph shows particularly a girder which broke off at the "quarter point," just where the main steel was bent up. A sort of continuous stirrup has been used throughout this building, and the whole stirrup reinforcing was pulled away with the surrounding concrete. In many cases the beam stirrups were almost entirely straightened out, and all steel, except in a few minor cases, was left clean of surrounding concrete.

At the remaining skylight header no stirrups are in evidence on the far side, but on the side next the adjacent columns stirrups are to be seen, showing where peeling has occurred.

A portion of the debris was taken from the general pile and mixed with water, after screening out the stone with a No. 16 sieve. This showed initial set in 24 hours, was set hard in 48 hours, and would show at least a 50 lb. tensile strength at the age of 66 hours.

Urge Oregon Highway Engineer Be Given More Power

At the recent annual meeting of the Oregon Society of Engineers, in Portland, Ore., J. P. Newell, one of the principal speakers of the evening, urged that the state highway engineer be given more complete charge of highway construction, with a view of unifying the work. The speaker pointed out that with 800 road supervisors participating in the direction of road construction, the state is getting highways built under a variety of systems.

Dam Colorado River in Grand Cañon

Work of constructing the first of three giant dams and hydroelectric plants in the Grand Cañon of Colorado River will be started in March, according to J. B. Girand of Phoenix, Ariz., engineer for the project. The initial dam will be constructed about 21 miles north of Peach Springs, Ariz., at a point where the cañon is very narrow and the inclosing walls reach 1500 ft. above the water level. In order to get material to the site, either a spur track will be built from the Atchison, Topeka & Santa Fe Railway at Peach Springs or a road will be constructed to allow the use of motor trucks.

It is proposed that the power generated by the plant will be sold to the numerous mines and mills in the vicinity at approximately $4 per horsepower month. It is said that it is now costing these mines and mills $8 to $15 per horsepower to generate their own power by steam. Upon the completion of the first project the available power will also be used in the construction of the other two. With the three plants in operation approximately 1,000,000 hp. can be generated. It is said that a market for this power will be found in northwestern Arizona and southern Nevada and Utah, a territory where there are not only many mines and mills, but which is rich in lumber and offers great opportunities in agriculture, provided power for pumping is available. The W. L. Clark Construction Company, of New York City, has an engineer on the site who is checking up plans and estimates.

Denver Steel Plant Plans Develop

Encouragement and every possible support on the part of the Civic and Commercial Association of Denver, Col., are extended to John A. Crook, proprietor of the Monarch Iron Works of Falls City, Neb., and Kansas City, in his determination to establish in Denver a factory, the output of which shall be structural steel of the sort necessary in large building operations and bridge work. Following conferences with officials of the association Mr. Crook recently closed a deal whereby the Lowith Iron Works at First and Larimer streets will be taken over as the nucleus of the new concern.

Cleveland Water Main Breaks

A 36-in. water main which broke at Cleveland, Ohio, Feb. 18 resulted in the flooding of nearly a square mile of streets, the filling of hundreds of cellars and a property damage estimated at $75,000. The break, which occurred early in the morning, is believed to have been caused by earth settlement under the pipe due to cold weather. The main, which had been in service eighteen years, had a piece 6 ft. long and 2 ft. wide broken from it. Frost had penetrated to a depth of 3½ or 4 ft. near the point where the break occurred.

Organize Engineers' Country Club on Long Island

An engineers' country club, with house and grounds on Long Island, has recently been organized and is promised to afford for its members all privileges of sport as well as that of community living. It is intended to develop about 240 acres of cultivated and cleared land, already obtained, on the north shore of Long Island near Roslyn. A manor house, at present on the grounds, will be altered to fill the needs of an all-year club house, 20 miles from Columbus Circle.

The engineers' country club will have 500 resident members, living within 50 miles of the club, and not less than 500 nor more than 1000 non-resident members, living over 50 miles from the club. Engineers by profession, members of engineering societies and those closely allied with the engineering profession are eligible for membership. Charles F. Quincy, of New York, is the president of the club. N. M. Garland, 30 Church Street, New York City, is chairman of the membership committee.

Compensation Laws of Three States Upheld in Supreme Court

The laws of three States as to workmen's compensation to be paid in case of personal injury or death in the performance of duty were, March 6, upheld by the U. S. Supreme Court in cases brought on appeal from the States of New York, Iowa and Washington.

The general principles underlying the cases were practically the same. The New York case was that of the New York Central Railroad in which a watchman was accidentally killed. The court opinion, sustaining the New York law, stated that he who expects to derive an advantage from an act done by another must answer for any injury the third person may sustain in such performance.

Pacific Coast Proposes Military Highway

The Pacific Coast Defense League has filed articles of incorporation at Olympia, Wash., with the object of securing the construction of a military highway from the Canadian to the Mexican border on the Pacific Coast. Congress will be asked immediately to make an appropriation for such a highway.

Backing the league in this movement will be the legislatures of Oregon, Washington and California. The Oregon legislature has already adopted a memorial to Congress, a similar one will be offered in the Washington legislature, and the third will be taken up by the California legislature in March. While the need of a military highway for coast defense has been talked of for some time, this is the first occasion when concerted action by the three Pacific Coast states has been possible.

What Engineers and Contractors Are Doing

E. B. MENUEZ, district engineer of the New York Central Railroad at Albany, N. Y., has been appointed assistant valuation engineer, with headquarters at New York City. Mr. Menuez was born in Ohio in 1875, and was educated at the National Normal University, Lebanon, Ohio. In 1898, after various city and county work, he entered the employ of the Baltimore & Ohio Southwestern Railway, where he remained until 1901, having meanwhile been made acting resident engineer. The next three years found him on various railroad construction west of the Mississippi River, with the Choctaw, Oklahoma & Gulf and the Missouri Pacific Railways and the White River Railroad. For a short time, also, he was with the city department at Columbus, Ohio. He came to the New York Central in 1904, and was first in charge of the general drafting room for the electric zone. Next he became a member of the chief engineer's special staff and had the handling of engineering agreements. Late in 1909 he was appointed engineer of grade crossings, and in the spring of 1912 was promoted to the office he now leaves.

N. F. THOMPSON, assistant district engineer of the New York Central Railroad at New York, has been made district engineer at Albany, succeeding E. B. Menuez, promoted. Mr. Thompson was graduated from Rensselaer Polytechnic Institute in 1907. Except for a short period with the Delaware & Hudson Company his engineering work has been entirely with the New York Central. In the grade-crossing office he was successively draftsman, assistant engineer, assistant engineer of grade crossings and engineer of grade crossings, reaching the latter position in the spring of 1912. A year ago he was promoted to assistant district engineer of the New York district.

S. L. RICE, having resigned from the position of office engineer, Delaware, Lackawanna & Western Railroad, the position has been abolished.

CLARK R. MANDIGO has resigned as assistant engineer for the Portland Cement Association to accept the position of consulting engineer for the Western Paving Brick Manufacturers' Association, Dwight Building, Kansas City, Mo. Mr. Mandigo, who was formerly assistant city engineer of Kansas City, Mo., will have charge of the service and promotional department for the brick association, which operates over most of the territory between the Mississippi River and the Rocky Mountains.

TOWL ENGINEERING COMPANY has changed its office from 1119-22 City National Bank Building to 1420-1 First National Bank Building, Omaha, Neb.

B. F. CRESSON, JR., whose resignation as chief engineer of the New Jersey State Board of Commerce and Navigation was announced in the Engineering Record of March 3, page 367, was educated at Lehigh University and University of Pennsylvania, and since receiving his degree from the latter school in 1894 has been actively engaged in engineering practice. For six years, until 1900, he was connected in various capacities with several different railroads, among them the Lehigh Valley Railroad, Pennsylvania Railroad and the Reading Subway work in Philadelphia. From 1900 to 1901 he was in the office of Jacobs & Davies, consulting engineers, New York City, on subaqueous tunnel plans and surveys of the North and East rivers. In 1901 he was assistant engineer on resurvey plans for the completion of the Hudson tunnels under the North River (McAdoo tunnels). From 1901 to 1910 he was assistant engineer, alignment engineer and resident engineer in charge of precise triangulations on the North River, resident engineer in charge of a section of the subaqueous tunnels under the North River and resident engineer in charge of a section of the Pennsylvania terminal in New York City. He was appointed first deputy commissioner of docks of New York City in 1910, during which time he visited Europe to study important harbors. From 1913 to 1915 he was chief engineer of the New Jersey Harbor Commission, and in the latter year was appointed chief engineer of the New Jersey State Board of Commerce and Navigation. Mr. Cresson will become consulting engineer to the board while engaged in private consulting practice at 50 Church Street, New York City. He has been retained by the Board of Dock Commissioners of Norfolk, Va., to prepare for them a harbor development plan.

Resigns as Chief Engineer of New Jersey State Board of Commerce and Navigation

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B. F. CRESSON, JR.

E. A. WIDMAN is at present chief draftsman with the Slidell Shipbuilding Company, Inc., Slidell, La. Mr. Widman received his education and early experience in shipbuilding in England, and later came to the United States, where he has had fifteen years' experience in building grain elevators, floating elevators, power plants, refrigerating plants, etc. Previous to his present position Mr. Widman was for a short time with the W. Backers Chemical Company, Brooklyn, N. Y.

J. F. BROWN, civil engineer and superintendent of construction, Quartermaster Corps, War Department, has been transferred from Fort Slocum, New York, to El Paso, Tex. At his new station Mr. Brown will supervise the construction of a complete water-supply and distribution system and sewerage system on the Fort Bliss military reservation. The project involves the expenditure of nearly $100,000. Mr. Brown was graduated from the engineering school of the University of Kansas in 1911, and was employed as superintendent of buildings and grounds at the University of Kansas, Lawrence, Kan., until March, 1914, when he accepted an appointment from the War Department as civil engineer and superintendent of construction, and was stationed at Fort Slocum, New York.

R. C. STORRIE, for many years a well-known contractor of San Francisco, and builder of the Mile Rock and Twin Peaks tunnels, was recently injured by a blast at Las Vegas, N. M., where he has a construction job under way. The charge exploded unexpectedly while Mr. Storrie was standing near, and flying débris caused injuries which, it was feared, would result in the loss of his right eye. Later reports indicated that the eye would be saved.

J. W. MORRIS, former city engineer, Portland, Ore., has been appointed consulting engineer of the Oregon State Motor Association. His duties will be to log all the roads throughout the state, prepare maps for the benefit of motorists, organize local automobile clubs in various communities, which will be affiliated with the state organization, and spread the gospel of statewide co-operation in good roads.

C. E. JOHNSTON has been promoted from the position of chief engineer of the Kansas City Southern Railway to that of general manager, with headquarters at Kansas City, Mo. Mr. Johnston began work with this company as a locating engineer and has been chief engineer since 1911. Since 1897 he has been in railroad work, beginning in that year as a chainman in southern Illinois. Mr. Johnston is 35 years old and is reported to be the youngest railroad general manager in the country.

C. B. CLEGG has been appointed acting division engineer of the Pecos division of the Atchison, Topeka & Santa Fé Railway, with office at Clovis, N. M. He succeeds J. W. Walker.

FRANK HELM has been appointed division engineer of the Atchison, Topeka & Santa Fé Railway, with office at Slaton, Tex. Mr. Helm holds a newly created position.

C. LOUIS ZULL has resigned as inspector on Ohio River lock and dam construction, and has become achitect's superintendent with the firm of Ritter & Bates, of Portsmouth, Ohio, and Huntington, W. Va. Mr. Zull was educated at the University of Cincinnati.

W. S. BARSTOW MANAGEMENT ASSOCIATION, 50 Pine Street, New York City, is announced by W. S. Barstow & Company, Inc. The new firm will supervise the management of all public-utility properties controlled by the General Gas & Electric Company, the Eastern Power & Light Corporation and W. S. Barstow & Company, Inc. E. L. West has been elected president of the corporation.

Obituary Notes

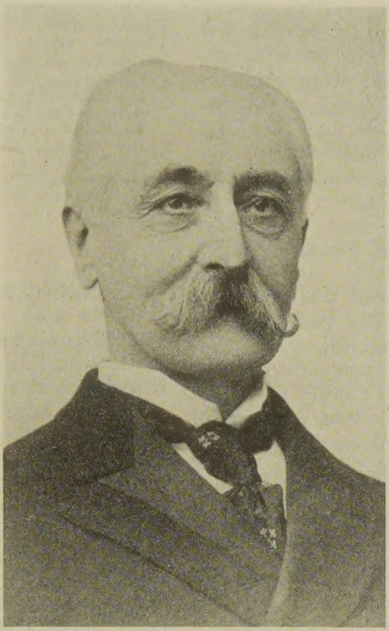
WILLIAM HENRY BALDWIN, for nearly ten years deputy city engineer of Yonkers, N. Y., died March 6 at his home, 103 Warburton Avenue, in that city. Mr. Baldwin was born in Nashua, N. H., and was a graduate of Dartmouth College, class of 1859. He had charge of municipal engineering projects in Memphis, Buffalo and Norfolk. In 1888 he was made engineer of the Yonkers Water Department, and when in 1908 the city was formed he became deputy city engineer. Mr. Baldwin was seventy-five years old. He served in the First New York Volunteers during the Civil War.

FRANK GILBERT, of the firm of Gilbert Brothers, engineers and contractors, died recently at his home in Westmount, Canada.

S. F. BULLARD, civil engineer, of Tacoma and Centralia, Wash., died Feb. 14 in Tacoma. He had been a resident of Tacoma since 1890. Mr. Bullard was a graduate of the University of Illinois and for many years was associated with the present city engineer of Tacoma, L. A. Nicholson, under the firm name of Bullard & Nicholson. He served as assistant city engineer of Tacoma during 1904-1911 and was city engineer of Centralia, Wash., during 1907 and 1908.

COLONEL WALTER KATTE, who was for fifty years active in railroad and bridge construction in this country, died suddenly March 4, at his home, 784 Park Avenue, New York City, in his eighty-eighth year. He was the first chief engineer of the Second and Ninth Avenue elevated roads, New York City, and he was identified prominently with the construction of the West Shore Railroad. Colonel Katte was born in London, England, and was educated in King's College. He came to this country in 1849 and his first engineering work was done in the West and Middle West. For four years he was in charge of the construction of the Eads steel arch bridge over the Mississippi River at St. Louis, and for ten years he was engineer and secretary of the Keystone Bridge Company at Pittsburgh, Pa. His railroad work included ten years in the service of the Pennsylvania Railroad, and he was also at one time chief engineer of the Ontario & Western Railroad. From 1886 to 1898 he was chief engineer of the New York Central & Hudson River Railroad. He resigned that place to retire to private life. One of the thirteen founders of the Western Society of Engineers, the Colonel was recently elected an honorary member of the organization. He was one of the early members of the American Society of Civil Engineers and served two terms as director of the Institute of Civil Engineers, London. In the Civil War Colonel Katte was assigned in 1861 as Colonel in the service of the United States Military Railroad and Telegraph Department. His duties were those of constructing engineer for military bridges and railroads in Maryland, the District of Columbia and Virginia.

Famous Railroad and Bridge Engineer Dead



COL. WALTER KATTE

GEORGE ANDREW HOBSON, a prominent English engineer, and until some few years ago a member of the firm of Sir Douglas Fox & Partners, died Jan. 25 at Richmond, England. Mr. Hobson received his early education at King James' School, Knaresborough, and afterward for three years studied science and mathematics at the Watt Institute, now incorporated with the Heriot-Watt College at Edinburgh. In 1871 he became an articled pupil at the Tees Engineering Works, Middlesbrough, and when just over twenty years of age was made chief of the drawing office. In 1880 he became chief assistant to Sir Douglas Fox and continued in that capacity for twenty years, during which time he was engaged on work connected with the Mersey tunnel and railway, the Hawarden Bridge over the river Dee, Liverpool Overhead Railway and the Great Central Railway extension to London. He was responsible for and was associated with railway work in India, Argentina, Colombia and other countries, and with extensive granaries at Buenos Aires, but it was in South Africa that his work abroad was most extensive and beneficial. Much of the bridge and structural steelwork on the lines connecting the Cape Colonies with Rhodesia, totalling in all more than 2500 miles of railway, was designed by him. One of the finest examples of his work is the bridge over the Zambesi River at Victoria Falls. It is notable as having the greatest combined height and span of any similar structure yet built, the central span of 500 ft. having a rise of 90 ft., while the height from low water to rail level is 363 ft. Mr. Hobson was a member of the Institution of Civil Engineers and was also a member of two of the engineering standards committees. In 1900 he received the Telford premium and gold medal and in 1907 the George Stephenson gold medal.

ERNEST L. RANSOME, since 1859 engaged in the study, use and manufacture of artificial stone, and to whom there are credited inventions and numerous important works in concrete, died March 5 at Plainfield, N. J., in his seventy-third year. Since entering as an apprentice in his father's factory at Ipswich, England, nearly sixty years ago, Mr. Ransome's whole life had been given up to the study of concrete and its applications. He was superintendent for four years of the Pacific Stone Company of San Francisco when the new process of artificial stone-making was introduced into this country in 1870. He was one of the first, if not the first, to use cold-twisted square bars for reinforcing and he holds patents on methods of forming joints in concrete, use of lime and clay and salt in concrete, use of coil joint for uniting reinforcing bars and other patents as well. He was for several years president and consulting engineer of the Ransome Engineering Company, and was an associate member of the American Society of Civil Engineers, charter member of the Western Society of Engineers, honorary corresponding member of the American Institute of Architects and member of the Royal Society of Arts.

Railroads Expect Greater Shortage of Labor

Statements Indicate That Construction Work Would Break Records During Coming Season if Labor Supply Would Permit

ENGINEERS in charge of maintenance work on important railway systems throughout this country and Canada consider in general that construction work to be carried out by their lines will be curtailed by the inadequate supply of labor, according to opinions expressed in the March issue of the *Railway Maintenance Engineer* in response to a request for information sent out by that journal. Although the labor field covered by these replies is slightly different from the construction field, the opinions expressed bear out the analysis of the labor situation given in the Engineering Record of Jan. 6 last, and indicate that throughout the northern sections of the country where conditions early became acute the labor shortage is expected to be no more severe than last year. On the other hand, it is indicated that railroads in this territory, in common with many other industries, have imported large quantities of negro labor from the South, and that a serious shortage is expected to be felt there for the first time during the coming season. Also, it is pointed out that under present conditions it is difficult for the Southwestern roads to recruit Mexican labor across the border, and that some shortage is being felt on this account. As for the Pacific Coast, it is shown to have been necessary for some roads to raise wages during the past season, and while wages were dropped to the former level during the winter, it is expected that they will have to be advanced when the lumber and agricultural season opens. It is reported to be extremely difficult to maintain an adequate supply of labor near large cities. While an acute shortage has, of course, existed in eastern Canada, things are not so bad in the Canadian Northwest. However, in common with our Western agricultural territory, the available labor is expected to shift to the farms during the summer, and some roads are planning to accomplish the greater part of their construction work before this takes place.

Buildings

The larger building projects noted in this issue are summarized below:

Contracts awarded:	Kind	Cost
Dayton, Ohio	Bank	$450,000
Rock Island, Ill.	Munitions plant	1,250,000
New Orleans, La.	College building	767,000
Proposed work:		
Atlantic City, N. J	Hotel	1,750,000
Wheeling, W. Va.	Steel plant	20,000,000
Youngstown, Ohio	Railroad shops	500,000
Cincinnati, Ohio	Courthouse	500.000
Chicago, Ill.	School	320,000
San Francisco, Cal	State building	1,000,000

Roads and Paving

Five highway contracts amounting to $378,000 have been awarded at Fayetteville, W. Va. The lowest bid received at Cleveland, Ohio, for paving construction on Euclid Avenue was $124,000. Bids are desired March 14 at Fargo, N. D., for highway construction to cost in the neighborhood of $300,000. Proposed work noted in this issue is summarized in the following table:

	Kind	Cost
Rustburg, Va.	Highways	$240,000
Tarboro, N. C	Street improvements	250,000
Spartanburg, S. C	Highways	1,000,000
Jacksonville, Fla	Paving	375,000
Greenwood, Miss.	Highways	600,000
Ashland, Ohio	Road work	250,000
Dallas, Tex.	Paving	500,000
Portland, Ore.	Highway construction	250,000

Waterworks and Sewers

Judging from the news of work reaching the Engineering Record, construction in this field may be much more active during 1917 than last year. Work noted in this issue is summarized below:

Contract awarded:	Kind	Cost
St. Paul, Minn.	Reservoir	$246,000
Bids opened:		
East St. Louis, Ill	Sewer	386,000
Proposed work:		
Pawtucket, R. I.	Sewers	400,000
Philadelphia, Pa.	Waterworks extensions	500,000
Allentown, Pa.	Sewage disposal plant	2,000,000
Bethlehem, Pa.	Reservoir	250,000
Springfield, Ill.	Water mains	175,000
Quincy, Ill.	Waterworks extensions	197,000
Grand Rapids, Mich.	Sewers	158,000
Milwaukee, Wis.	Filtration plant	3,000,000
Wichita, Kan.	Sewer	200,000

Miscellaneous Headings

A contract has been awarded for constructing a power plant to cost $6,000,000 at Wateree, S. C. A dock contracted for at Seattle will cost $350,000. Bids are desired April 3 at Philadelphia for three additional sections of the Broad Street subway.

The bill appropriating $45,000,000 for flood control on the Mississippi River, not more than $10,000,000 of which is to be spent in any one year, passed both the Senate and House at Washington. It is reported that the Lehigh Valley Railroad will expend $5,000,000 during 1917 for work including the completion of four-tracking its line from the anthracite fields to New York harbor. The naval appropriation bill includes provision for a $750,000 drydock to be constructed at Charleston, S. C. Reports from Youngstown, Ohio, state that the Erie Railroad will expend $5,500,000 for construction improvements. Plans are being prepared for a steel bridge to cross the Ohio River at Louisville, Ky.

A survey of a drainage district near Helena, Ark., which will cost $3,778,000 has been completed. Plans for the construction of a hydroelectric plant at Rochester, Minn., to cost $600,000, are said to have been completed. Applications have been made to the state water commission of California for permission to use water for an irrigation project to cost $800,000 and for hydroelectric developments to cost $7,500,000. San Diego, Cal., provided $682,000 on Feb. 21 for the reconstruction of the Lower Otay dam. Three dams to cost $927,000 are to be built in connection with the flood-control work at Los Angeles.

WATERWORKS AND SEWERAGE SYSTEMS

PROPOSED WORK

Pawtucket, R. I.—City Council reported to have voted to ask legislature to authorize $800,000 bonds to be used for sewer and highway improvements.

Woonsocket, R. I.—Reported Bd. Sewer Comrs. considering construction of South Main St. trunk sewer; cost $12,000. M. H. Bronsdon, city engr.

Canandaigua, N. Y.—Reported city has a movement on foot for construction of sewage disposal plant.

Potsdam, N. Y.—Village will hold election some time in March on question of issuing $190,000 bonds to be used for waterworks improvements between Barton Brook and Potsdam.

Bayonne, N. J.—City is desirous of purchasing plant and system of New York & New Jersey Water Co., for which $3,000,000 is asked. Bayonne is willing to pay $600,000 after receiving advice of engrs.

Passaic, N. J.—Bd. Comrs. have decided not to construct the $50,000 Paulison Ave. storm sewer, owing to the impending war situation and present high cost of materials.

South Orange, N. J.—Clyde Potts, 30 Church St., New York, has drawn plans for trunk sewer system for South Orange Twp., Rahway, Cranford and other municipalities that may care to enter the project. A. W. Hemphill, of Montclair, reported head of private interests, which are considering the construction.

Westfield, N. J.—Clyde C. Hill, village engr., writes election will be held Mar. 20 on question of improving present waterworks; cost $80,000. J. A. Riley, village clk.

Kittanning, Pa.—Reported city considering construction of waterworks. H. J. Walter, ch. of Council.

Allentown, Pa.—Site has been purchased for sewage disposal plant and sewer system will be installed; cost about $2,000,000.

Bethlehem, Pa.—Ross Common Water Co., of Ross Common, plans construction of 300,000,000 gal. capacity reservoir; cost $250,000.

McKeesport, Pa.—City considering extensive improvements to waterworks, including additional mechanical filters, high service distributing system, stand pipe, clear water reservoir, new pump and power house. Leo Hudson, engr., 802 House Bldg., Pittsburgh.

Monaca, Pa. — Boro. Engineer Michael Baker in his report on proposed waterworks improvements recommends installing additional power at waterworks and improving reservoir; though investigation revealed cost of installing 2 new centrifugal motor driven pumps each having 1,000,000-gal. capacity, would not cost any more than it would to put present pump in working order; cost of 2 new pumps installed, $10,000 ;also 1,000,000-gal. capacity reservoir at $10,000.